THE

ELECTRICAL REVIEW.

VOL. L. FEBRUARY 14, 1902. No. 1,264.

CONTENTS:

	PAGE
Extra High Pressure and the Board of Trade	245
Some Results of a Secondary Battery in a Traction Station ...	247
The Leakage of Current from Buried Bare Conductors (*illus.*)	248
The Economy of Isolated Electric Plants	250
Company and Consumer	251
Correspondence:—	
A Perfect Wheatstone Bridge	251
The Testing and Management of Electric Motors ...	252
Is Visions About?	252
Jointless Car Cables, Patent No. 12,862	252
Soldering Fluids	253
Legal	253
Business Notes	254
Bermondsey Electricity Works (*illustrated*)	263
The Westinghouse Integrating Wattmeter (*illustrated*) ...	267
Supply Station Accounts	270
City Notes	270
Traffic Receipts	274
Stocks and Shares	274
Share List of Electrical Companies	275
Market Quotations	276
Institution of Electrical Engineers:—	
Earth Currents Derived from Distributing Systems (*illus.*) (*concluded*)	277
Institution of Electrical Engineers (Manchester Section) ...	278
Engineering Employers' Federation and the Trades Unions, with Notes on Piecework	278
Current Specifications.—XCI.	279
The Testing of Motor Losses (*illustrated*)	279
Wireless Telegraphy	281
Technical Terminology	282
Recent Development of the Atomic Theory and its Connection with Light and Electricity (*concluded*)	283
New Patents	284
Abstracts of Published Specifications	284

THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 15 Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

EXTRA HIGH PRESSURE AND THE BOARD OF TRADE.

THE discussion of Mr. Earle's paper upon the "Supply of Electricity in Bulk," at the Manchester Section of the Institution of Electrical Engineers, did not go far towards solving the important problem of how to work the power schemes in the most practical way.

Since it took place we have published the important letter of the Board of Trade to the London Chamber of Commerce, dealing with the questions of extra high pressure, and the use of bare overhead wires, subjects which might well have occupied the attention of Mr. Earle and those who commented upon his paper. The engineers who took part in the discussion do not appear to have grasped the most important issues, and the debate left much to be desired.

The necessity for comprehensive systems of supply over large areas is conceded; the practical question is, How to do it most advantageously? The Electrical Trades Section of the London Chamber of Commerce has pointed out the key to the position in advocating, as vital to the commercial success of such undertakings, the use of overhead wires outside urban areas, the success of which has been proved in those countries where long-distance transmission has been already established.

It is to be regretted that neither Mr. Earle in his paper, nor those who discussed it, dealt with what appears to be the crux of the question; but the letter of the Board of Trade clears the way to the solution of the problem, by the declaration that the regulations for "aerial lines" do not apply to extra high pressure, and that the Board of Trade are prepared to allow the use of bare overhead wires when the conditions of the undertaking justify it and when they are satisfied with the precautions proposed to be adopted.

The continuance of the Power Schemes Committee of the Electrical Trades Section of the London Chamber of Commerce is a wise decision, as it is most important that the engineers engaged in working out the systems should focus their views and experience by the frank interchange of opinions, and arrive at some common basis, so that the schemes put before the Board of Trade should be uniform in their leading principles.

Some misconception has hitherto existed in supposing that the Board of Trade regulations applicable to high pressure covered extra high pressure also, and hence the demand for a necessary modification to meet the long-distance transmission schemes by overhead wires; but it is satisfactory to find that this was an erroneous interpretation of the regulations, and that they were not intended to apply to extra high pressure, such as is involved in the carrying out of the large schemes covered by the Power Bills.

The subject is of so much importance that the Council of the Institution of Electrical Engineers ought, we think, to arrange for a paper to be read on the subject at an early

date by some member capable of dealing with it in a thoroughly practical and impartial manner.

During the discussion of the Power Bills before the Parliamentary Committees, sufficient evidence was given as to the practicability of the schemes to warrant the passing of the preambles of the Bills, in spite of the efforts of the experts acting for opposing local authorities, but much remains to be settled before the Board of Trade can be asked to sanction conditions reasonably applicable to power schemes as a rule. Exceptional cases will, of course, arise, which must be dealt with on their merits, but it is most desirable that some understanding should be arrived at upon many general principles.

The Board of Trade, instead of making hard and fast regulations and requiring the engineers to work to them, give them freedom to submit the schemes best adapted for the purpose, and hence the importance of united action in order to produce the best system for carrying out the supply over large and varying areas.

The Power Schemes Committee of the Electrical Trades Section of the London Chamber of Commerce offers a suitable centre for the conference of all who are engaged in devising practical means of carrying out those great schemes for which legislative sanction has been obtained, and it is most desirable that the highest available engineering ability should be concentrated on the undertakings.

The Institution of Electrical Engineers might render valuable aid, by offering a substantial prize for the best essay upon the generation, transmission, and distribution of electrical energy, suitable for power schemes in the United Kingdom. Such a competition would be worthy of the efforts of every electrical engineer ambitious of attaining the highest rank in his profession.

The general principles laid down by the Board of Trade will probably be accepted as a reasonable basis, as they appear to possess the necessary elasticity for coping with the conditions of each specific case; and what we require now are specifications in detail for typical cases involving the supply of a mixed urban and rural area, this area containing towns and villages with manufacturing and residential communities, electric trams and railways, haulage on canals, and all the varying conditions under which electrical energy can be usefully employed.

Underground Railways.

Two important pronouncements affecting "tube" railways appear in our "Traction Notes" to-day. One is the summary of the report on vibration on the Central London Railway, and the other the discussion in the House of Lords respecting the new lines. The former finds, as has been known for some time, that vibration actually exists, and recommends certain measures for its prevention in future, measures for which, of course, the company has been making preparations for some time past. The latter renders it more than possible that the tube schemes "brought forward" from last Session, also those which have been newly placed upon the paper during the past few months, may be definitely dealt with very shortly. We entirely agree with all efforts that are made to obtain uniformity in connection with laying out underground London, so that the interests of the travelling public shall be considered before the fancies of promoters, but another year's delay so that this end might be attained seems quite unnecessary.

"I want yer Marconi!"

The Toronto correspondent of the *Times* has developed a remarkable affection for Marconi, and expresses his feelings in nearly a column of appreciation, which we have read with interest, tempered by amusement. He seems convinced that wireless telegraphy across the Atlantic will be commercially practicable, and that it will in all probability compete with existing telegraphic communication. He is far-sighted enough to declare that if Marconi brings a cheap service within reach he will be forwarding an important national purpose. The entrance to the St. Lawrence lies along the fog-infested shores of Newfoundland. Any invention or system which promises to put a ship in easy communication with the shore or with other ships by night or day, in fog or sunshine, will remove the chief dangers of the passage. So he says. We can imagine such a ship in such a fog inquiring its way from an unknown shore that it cannot see, and that cannot see it, to an unknown destination. To its signal of distress: "I want yer, Marconi," there would come from a hundred simultaneous oscillators, the immediate question: "Where are you?" responded to by the distracting answer, "I don't know," followed by opprobrium. If the Toronto correspondent would only read his *Times* he would find several articles and letters bearing on this subject, which would enable him to form a just estimate of the enormous difficulties which yet stand in the way of the adoption of such a scheme as he has formulated.

The *Electrical World and Engineer*, of New York, gives a "graphic narrative" extracted from McClure's *Magazine*, describing the circumstances attending the experiments on Signal Hill on December 12th. Only two persons were in the room—Mr. Marconi and Mr. Kemp. Everything was done that could be done. The receiving apparatus was of unusual sensitiveness, so that it could catch even the faintest evidence of the signals. A telephone receiver had been supplied, so that the slightest clicking of the dots might be conveyed to the inventor's ear. For nearly half-an-hour, says this report, not a sound broke the silence of the room; then quite suddenly Mr. Kemp heard the sharp click of the tapper as it struck against the coherer—this, of course, was not the signal, yet it was an indication that something was coming. The inventor's face showed no evidence of excitement. Presently he said: "See if you can hear anything, Mr. Kemp." Mr. Kemp took the receiver, and a moment later, faintly and yet distinctly and unmistakably, came the three little clicks—the dots of the letter S, tapped out a moment before in England. At 10 minutes past 1 more signals came, and both Mr. Marconi and Mr. Kemp assured themselves again and again that there could be no mistake. During this time the kite gyrated so wildly in the air that the receiver wire was not maintained at the same height, as it should have been; but again at 20 minutes past 2, other repetitions of the signal were received. The inventor, subsequently, was unable to obtain continuous results, owing to the fluctuations of the height of the kite as it was blown about by the wind, and to the extreme delicacy of his instruments, which required constant adjustment during the experiments. The signals, in fact, were blown higher than a kite.

Wireless Telegraphy.

In the article which we publish on another page, Mr. Sullivan attacks the subject in a bold and novel manner, raising a number of points which have been but lightly touched upon, if at all, by our other correspondents. For example, we have always been assured that wireless telegraphic communications were unaffected by weather conditions, but Mr. Sullivan adduces evidence to the contrary. Again, the susceptibility of the system to wilful interruption on the part of others, whether commercial rivals or national enemies, is a serious drawback. If any means of overcoming this is in existence, where is an account of it to be found? Mr. Sullivan draws attention to the maximum speed of wireless telegraphy—25 words per minute—and the extreme distance attained in practical work, 300 miles.

Compare this with the 150 words per minute, or 300 words with duplex working, of a submarine cable of equal length! The importance of Dr. Lodge's priority of invention in applying an induction coil or step-up transformer in the receiving circuit, as now generally used for receiving signals over both long and short distances, is also emphasised by Mr. Sullivan. This appliance, which in some form or other, having but slight impedance, now exists in most systems of wireless telegraphy, is absolutely essential to successful working over long distances, and is always beneficial.

Steam Boilers.

Mr. Stromeyer's paper before the Manchester Section of the Institution of Electrical Engineers may not have contained much that was new or unknown, but matters were presented in a novel and interesting light, and various points of practice were brought forward from obscurity. He endeavoured to compare the expense of keeping boilers with banked fires under steam and getting up steam from cold water. The question is complicated with the Lancashire and water-tube boiler by the mass of surrounding fire-brick, but in marine return-tube boilers certain trials seem to show that in getting up steam from cold water the fuel was used at as high an efficiency as 80 per cent. On account of the brickwork the Lancashire boiler will not work at its full efficiency until the bricks are heat-saturated. The marine boiler works at full efficiency as soon as it has full steam pressure. Water-tube boilers in which steam is got up quickly, may take hours to attain their best efficiency, because they have so much brickwork to heat up after the boiler is fully hot. The author points out with some satisfaction, that in recent Navy trials, the steam has been got up as quickly as was possible. He says of this that there must have been powerful circulating pumps to enable it to be done, but he has "never seen any reason why one should not be able with the help of pumps to raise steam in this type of boiler with great rapidity." He states further that there is no danger to be apprehended where a difference of 100° F. is not exceeded, and the whole of the water in a boiler would be circulated in 15 minutes by a pump of reasonable dimensions. This is a question that has often been dealt with in these columns. A large marine boiler holds, perhaps, 3,000 gals. of water. This amount would flow through a 4-in. pipe in 15 minutes, with a head of only about 3 ft. As a pump must only circulate the water, and does not do any other work, it is evident that a 3-in. centrifugal pump made for volume and not for pressure would keep a large boiler at practically uniform temperature during steam raising. Indeed, with a range of boilers properly connected in series, one pump would prevent temperature differences in a whole battery of boilers. An equalising steam pipe would also be needed. Where a sudden demand for steam is to be expected, of short duration, Mr. Stromeyer does not object to carrying a high water level —say up to the top of the gauge glasses—and when the larger demand comes on, stopping the feed and letting the level drop as low as is safe, thereby increasing the steam output about 20 per cent. for Lancashire boilers, and at the same time using the economisers to generate steam in place of warming feed water, but he does not advise that economisers should be so treated regularly. Why, however, need the economiser be allowed to become so very short of water at such a time? It might, perhaps, with advantage be allowed to run dry in the top boxes, but we see no reason why it should not be kept fed up by the amount of evaporation. To do this satisfactorily, there should be a steam drum to the economiser, to be used on such occasions, the better to collect dry steam and deliver it to the boilers. Mr. Stromeyer rightly insists that boiler capacity must be sufficient to prevent the necessity of forcing, which wastes coal. It is pointed out that marine engines are now run without cylinder lubrication, for the moisture in the steam is sufficient. With superheat lubrication is necessary, and then there are grease troubles in the boiler, and this is a point that must be considered where superheat is adopted. Some useful tables of boiler cost and durability are given, which may be studied with advantage.

SOME RESULTS OF A SECONDARY BATTERY IN A TRACTION STATION.

[COMMUNICATED.]

The interest in traction stations with batteries for smoothing out the peaks and improving the plant load factor is very general at the present time, and no apology need be offered by the writer for introducing the subject, especially in view of the paucity of published results. The writer was forced to consider the question of extensions to a plant already supplying a tramway system, where the maximum load on the power house was more than double the mean load, hence it was obvious that before purchasing new plant the alternative plan of a battery must be seriously considered.

With a view to seeing what was being done elsewhere the writer visited one or two stations where batteries were in operation, and in every case the results were satisfactory to an almost unexpected degree. The chief features were decreased maximum load on the plant, with consequent saving in capital, and decreased coal and labour cost, the former as a result of improved load factor and the latter due to the smaller amount of running plant.

The line to which the writer particularly refers operated a varying number of cars, but generally 24 to 28 cars, with some 17,000 to 20,000 car-miles per week. The maximum load often reached 410 KW., though this was only momentary, while the mean load over the week never exceeded 175 KW., and was often less. Under these conditions a battery appeared to be a most promising investment, with the added inducement of economy in coal and labour.

The average water consumption of this plant, which, by the way, consisted of three 200-KW. steam dynamos, two of which were generally operated in parallel, worked out at about 58 lbs. per KW.-hour. In extenuation of this performance it must be noted that the mean load was less than half the engine's rated power; nevertheless, it is not a particularly creditable performance. Subsequent tests show that the steam consumption with the battery in parallel is only about 38 lbs. per KW.-hour, a performance sufficiently good to partly restore one's confidence in the steam engine as an economical prime mover.

The station cost approximately £21,000, and the reduction of the plant by 30 per cent. consequent upon one unit being on the load, instead of two as formerly, one being always kept in reserve, meant a reduction of the capital charges chargeable against the tramways, as the plant set free could be used for other purposes. This reduction was, however, nearly offset by the additional capital sunk in the battery and booster, hence there was no real saving in capital; there may be in some cases, but on considering the matter carefully the writer cannot see much prospect of more than a 10 per cent. saving on a corresponding steam plant. This is not, however, vital.

As the plant has not been in operation for a year, actual costs over an extended period are not yet available; the costs are from week to week fairly uniform, and a typical sheet (without the battery) is given below.

The standing charges given are $\frac{\text{annual charges}}{52} = £36{\cdot}3$, and coal cost 8s. per ton delivered; the consumption varied from 80 to 84 tons per week.

Table I.

	£ s. d.	Pence per unit.
Coal	32 11 0	= ·349
Labour	22 7 0	= ·248
Repairs	6 0 0	= ·065
Oil, &c.	4 10 0	= ·049
	65 8 0	= ·711
Capital charges...	36 6 0	= ·4
Total	£101 14 0	= 1·111

Units generated per week, 22,000.
Car-miles per week, 18,400.
Units per car-mile, 1·2 at power house switchboard.
Cost of energy per car-mile = 1·31d.

The cost of introducing a battery and reversible booster, including a battery switchboard, was about £6,000. Interest and depreciation on these items replaced that saved from the supersession of the steam plant.

D

Once running, the plant, from the shift engineer's point of view, was a huge success; the main ammeter needle did not now move more than 7 amperes either way, whereas formerly it was all over the scale every minute or so, especially on a Saturday, when heavily loaded cars often had to start on a gradient of 1 in 8.

The most marked decrease was in coal, which came down from fully 80 tons to about 55 tons. One boiler and one fireman and a trimmer did the work formerly done by two boilers and two firemen with a trimmer.

So far as we have been able to measure the proportion of the energy passed through the battery, this appears to be about 16 per cent. of the total units sent out from the station; the losses due to the battery are, therefore, small compared with the total. This is apparent, for, although the battery efficiency is in the region of 85 per cent., the ratio of units sent out of station to units generated is sometimes over 90 per cent.

Much has been said of the energy required to drive the reversible booster; this has been put at all sorts of extravagant figures, but the writer finds it to be about 2½ per cent. of the units generated. On week days, when the fluctuations of the traction load are not so violent as on Saturdays, it is even less than 2 per cent., hence, on a line with fewer gradients, the latter figure would probably prove the average.

In order to keep the additional battery records, especially as the battery room is not very convenient to the engine room, an attendant is employed, which adds £1 per week to the costs. This, although a small amount, could probably be saved in the majority of stations; it might, however, be added to the chief engineer's salary, on the principle, "Unto him that hath shall be given."

A typical week's cost sheet is given below, the figures relating to a week when the car-miles were almost the same as for the week quoted in Table I. :—

TABLE II.

	£ s. d.		Pence per unit.
Coal	22 9 0	=	·224
Labour	18 11 0	=	·186
Repairs	5 10 0	=	·055
Oil, &c.	3 0 0	=	·03
	49 10 0	=	·495
Capital charges...	34 12 0	=	·346
	£84 2 0	=	·841

Units generated per week, 24,010.
Car-miles per week, 18,412.
Units per car-mile = 1·3 generated.
" " = 1·2 at switchboard.
Cost of energy per car-mile = 1·09 pence.

$$\text{Ratio } \frac{\text{units at switchboard}}{\text{units generated}} = 92 \text{ per cent.}$$

This 8 per cent. loss appears as energy to drive booster, loss in battery, and minor losses. The net reduction in cost per unit generated amounted to about 24 per cent., a very substantial reduction; but this was reduced by losses in the battery, &c., to a reduction of 16·2 per cent. in the cost of energy per car-mile, a very substantial saving after paying all fixed charges on the new plant, being practically an increase of nearly £700 per annum on our income. It is not all investments in a modern power station which pay as well. Lest all should rush for batteries and boosters, it must be borne in mind that their advantages decrease rapidly where comparatively level lines are operated.

The writer knows of several lines operating fully 100 cars on level roads where, after having gone into the question, he does not consider a battery would be a profitable investment; peaks do exist on the station load curve, but they are few, and relatively small compared with the mean load. It is the relation of the peaks to the mean load which determines whether or not a battery would be a paying investment. This does not affect the question as to whether or not a battery should be placed in a sub-station some distance from the power house to take the irregular load due to a line stretching some distance into the country and operating probably relatively few cars. This is an entirely different question, and is determined by the drop in the rail returns, amount of feeder copper, and a variety of other questions, which did not influence the choice of the battery in the above case, situated as the power house was near the centre of the line.

THE LEAKAGE OF CURRENT FROM BURIED BARE CONDUCTORS.

THE entirely novel problems which arise in electric traction work from the use of bare conductors in contact with the earth throughout their length, and through which large currents are carried, are opening up a new line of thought and study for electrical engineers. Attention was for many years directed principally to the effects of the currents locally upon masses of metal already laid in the subsoil and the dread that electrolytic action would cause serious troubles brought a crop of papers, memoirs and articles before the technical reader. A rather more scientific turn has been given to the subject by the attention now being directed to the leakage paths and the general laws which govern them, and the recent paper by Mr. E. Basil Wedmore before the Institution of Electrical Engineers is a noteworthy contribution to the literature dealing with the general question indicated by the heading to this article. The paper itself, which has now appeared in abstract in our other columns, should be read, to do justice to the author's presentment of the recent work done in what he is right in regarding as an important subject, while his closing remarks on the lack of information about it should stimulate the traction engineer to apply some of the methods mentioned in the paper to its elucidation, as it is only by the accumulation of data from various systems at work that the correctness of the theories advanced can be tested.

Mr. Wedmore's method of investigation may be classed as the magnetic observatory one. Instead of attempting to measure pressures or currents, he set to work to find what magnetic effects were produced by the earth and return currents, using a magnetometer to measure the forces acting on the instrument, and from the well-known formulæ giving the magnetic field due to a current in a conductor of great length he deduced the current. Other workers on the subject, like Mr. E. Parry, have proceeded by measuring the fall of pressure along the return path, and employing a magnetometer, and from the measurements obtained have compared the current in the line with the total current. A pilot wire along the track has also been used to take the potential at various points.

The most interesting contribution to the discussion on the paper was made by Mr. A. P. Trotter, who has been kind enough to favour us with the illustrations which we reproduce, and which represent the three-dimensional models he exhibited during the course of his remarks. Although Mr. Trotter has shown such models at the Royal Institution and elsewhere, engineers do not generally seem to have grasped their value or the significance of being able to show more than can readily be indicated by curves plotted on a plane. By their aid it is possible to make some points clear and intelligible that otherwise are involved and give rise to lengthy explanation.

Mr. Trotter referred those who were in doubt as to the "source and sink theory" to a consideration, not merely of the earth currents, but to the difference between the currents in the rails of a traction system and in the trolley wire. If, he said, the current came back by the rails it would balance the outgoing current in the trolley wire, and as earth currents have no vertical component the presence of such an effect must be due to the trolley-wire current.

Buried masses of metal formed a conducting system which might lie in a current stream. Although normal earth currents on a telegraph wire might attain considerable values, they could not become large over a few hundred yards only. Great care had to be taken to avoid polarisation effects, but he had found values, miles away from a line, similar to those given by Mr. Wedmore. The only quantity measurable was the potential difference or earth-volts, as the currents themselves could not be passed through an instrument. The sort of thing that took place was indicated

adopted. Some useful tables of boiler cost and durability are given, which may be studied with advantage.

Interest and depreciation on these items replaced that saved from the supersession of the steam plant.

D

by saying that if a tramway was laid down a county might be short-circuited as regards earth currents. In taking the potential differences, a steel rod ¼ in. diameter and a yard long was driven into the earth, but the paths of current-flow depended so much upon the condition of the earth that emptying a bucket of water over the spot being tested might completely alter the direction of the current.

Coming to practical conclusions, Mr. Trotter was not quite prepared to agree with Mr. Wedmore as to the

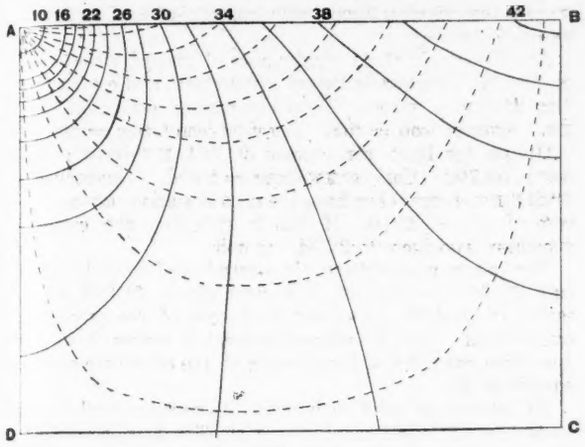


Fig. 1.

advisability of connecting all pipes to the rails of a traction system. It was very difficult to know what was meant by the term "earth potential" near a tramway. Many engineers objected to the connecting of pipes with the rails, while others argued that currents which got in were best led out again by a metallic path.

To investigate the forms of the current paths, adapting a suggestion in J. E. H. Gordon's "Electricity and Magnetism," Mr. Trotter soldered 20 pieces of wire along each side of a piece of sheet tin and passed one ampere in at each wire, taking the whole of the current off by one point. Fig. 1 shows the result. A B is the line into which the current is fed at 20 equi-distant points. A is the point at which all the current leaves the sheet. The full lines are equi-potential lines, as found by a probing galvanometer used as detector in the experiment; the dotted lines are lines of flow at right angles to the former and deduced from them. Owing to the limited size of the sheet, the conditions are artificial, and the lines are distorted near the edges B C and C D. The figures represent potential differences. The

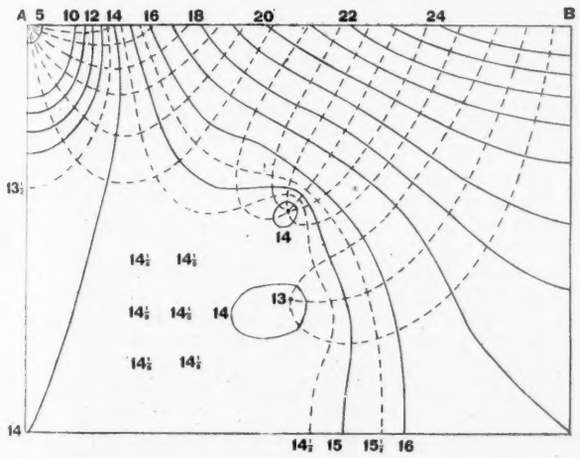


Fig. 2.

probing galvanometer was a Weston low reading instrument without added resistance reading $\frac{1}{100}$ of a volt to 40° deflection. The experiment was a most fascinating one. Then an alteration in the points was tried with a view of finding a place free from stream lines—an ideal position for a magnetic laboratory if the conditions were realised in practice. In fig. 2 A B is the line into which current is fed. Some of it leaves the sheet at A. At two points on the sheet the potential is reduced to "13" by tapping off some of the current, leaving a considerable space at a nearly uniform potential of "14⅛." Fig. 3 is another case similar to fig. 1, A and B being the line into which the current is fed. A and B are points at which the current leaves the sheet. In this case there is no appreciable distortion at the edges.

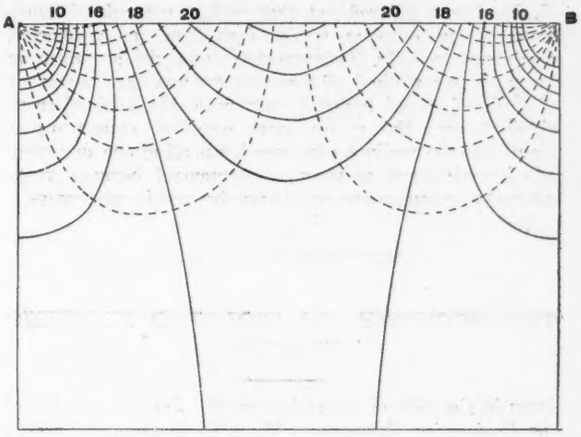


Fig. 3.

The solid or three-dimensional models are illustrated as far as perspective can show them in figs. 4 and 5. The first of these represents fig. 1, the thickness of the material being proportional to the potentials, the dotted lines being current streams and the full lines equi-potential surfaces shown on end. The current flows down hill in the model in the same way as rain drops would run down to the front right-hand corner over the curved surface of the solid. The solid model then represents the current flow back to the negative earth plate at the power house end of the line with a uniform loading of cars on the line. In fig. 5 the solid is typical of a line with a negative booster at the far end; in this case (which is shown as plane curves in fig. 3) the flow is from the centre in each direction, and the stream lines run from an electrical watershed right and left, while a set of the equi-potential lines, or surfaces, have tangents at the centre of the model in a direction at right angles to those nearer to the sinks at either end. This model brings out the interesting feature that the normal earth potential is a plane parallel to the base of the model at half its thickness, and the potential gradient runs out to a tableland towards the back.

Mr. Evan Parry referred to his theory mentioned in the paper, and said it was formed to account for facts accumu-

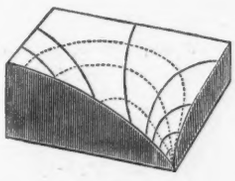


Fig. 4.

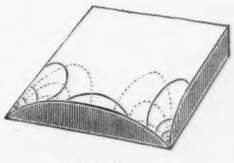


Fig. 5.

lated from practical sources, and took into consideration the relation between surface conductance and internal conductance, as well as the exponential character of the factors of current and pressure. Leakage was found to be independent of weather conditions and location. The earth acted as a solid homogeneous conductor, and it was naturally concluded that if the equilibrium of the earth's potential was disturbed, the earth made use of the whole of its bulk to restore the equilibrium. He considered that a portion of a rail was at earth's potential, where currents ceased to flow into it, and began to flow out. Surfaces at considerable distances underground were very much larger, and more intimately in contact than those at less depths, and this line of reasoning

a line stretching some distance into the country and operating probably relatively few cars. This is an entirely different question, and is determined by the drop in the rail returns, amount of feeder copper, and a variety of other questions, similar to those given by Mr. Wedmore. The only quantity measurable was the potential difference or earth-volts, as the currents themselves could not be passed through an instrument. The sort of thing that took place was indicated

served to explain why large masses of metal pipes were of little value in adding to the conductance of the earth as a whole.

The homogeneity of the earth was disputed by Mr. S. F. Walker, who held that the ground was an aggregation of very minute particles of a substance which itself had a high resistance, and that it followed that the conductivity actually found was due to moisture held in the spaces between the particles. The surface of the ground was merely wetted for a time, whereas lower layers were permanently moist. Mr. H. M. Sayers pointed out that with a network of track cross-country currents would invalidate magnetometric measurements. Mr. Wedmore stated that the argument in favour of his method of measurement was that the curve of readings agreed approximately with the kind of curve obtained from the power house recording ammeters; at night time the readings were small, but all in one direction. His intention was to show an agreement between magnetometer measurements and those obtained in other ways.

THE ECONOMY OF ISOLATED ELECTRIC PLANTS.

SUCH is the title of an article in the January number of the *Engineering Magazine* by Mr. I. D. Parsons.

The author's object is to institute a comparison between the costs of generating electrical energy on the spot and taking it from the street mains. It is generally admitted that for an installation of, say, 500 16-C.P. lamps, electricity can be generated as cheaply by the individual as by the public supply company. Consideration of space, convenience, vibration, nuisance, &c., however, must be weighed in the balances, and these are often of sufficient moment to turn the scale in favour of the public supply.

To take actual examples, however, and attempt to ascertain which of the two methods is the more economical, one is met at the outset with the difficulty that accurate accounts of costs are very rarely kept by the owner of a private installation. He knows in an indefinite sort of way (or thinks he knows) whether or not his electric light costs him more or less than gas, and with that vague knowledge he is generally satisfied.

In the discussion on Mr. Kapp's paper, read before the Society of Arts in 1893, on a similar subject, Mr. Fletcher Moulton probably expressed the general attitude of the country squire when he said that he retained his peace of mind by abstaining from learning how much it cost him to make his own electricity.

A country house installation is usually run more from considerations of convenience and cleanliness than from the economical standpoint.

It is, however, a matter of some surprise to find that shrewd business people, such as large hotel proprietors, property owners, mill owners, manufacturers, and the like, take so little pains to ascertain the cost of working their electrical plants. That this feature is not a characteristic of this country only is evidenced by the experiences of the author of the article under consideration. Over 250 buildings were visited in the effort to obtain reliable figures and the conditions of operation. Of this large number only 17 were found where accurate information in every particular was obtainable. Six classes of buildings were taken—viz., office buildings, loft buildings, department stores, apartment houses, hotels and clubs.

In the large New York buildings plant is often put down for elevators, heating, refrigerating, ventilation, steam cooking, laundry work, &c., so that the addition of electric light plant does not necessarily involve much extra labour. In order to allocate the cost of labour, fuel, and other expenses, figures were obtained from buildings using steam for heating and for house pumps only. It was found that the costs per 1,000 cubic ft. heated were practically constant, and were irrespective of the shape and size of the building. As the cost per ton of coal is not given, nor the time covered by the figures, they do not teach us very much.

Full details of the costs of electrical energy, reduced to dollars per kilowatt-hour, are given in tabular form, including the load factor, size of plant, capacity of storage battery (if any), hours of running, &c.

Interest is reckoned at 5 per cent. on the capital outlay; depreciation of machinery, 5 per cent.; of boilers, pumps, and piping, 8 per cent.; of batteries, 10 per cent. The tables and curves would take up too much space to reproduce, and would not, of course, be so useful as figures relating to English installations. They are, however, interesting, so we give the principal figures only from typical cases, reduced to English money.

An office block, of 11 stories, area of ground plan 50 ft × 120 ft. Electrically lighted throughout, and containing four 25-H.P. elevators. Total capacity of generators 260 KW. Average load = ·55. Lighting load factor = ·24.

Output for light per annum 91,804 KW.-hours; for power, 59,760. Cost per KW.-hour = 2·85d. This includes 19,293 KW.-hours taken from the central station service at a cost of about £280. If this is deducted, the cost of generation is reduced to 2·75d. per unit.

The whole service from the central station would have cost £2,900 per annum, as against about £1,800, or a saving of £1,100 per annum in favour of the privately-owned plant. This is perhaps the greatest saving shown in any of the examples, although some of the others are almost equally good.

An interesting point is brought out as regards what are known as loft buildings, which are let off in floors to various tenants for manufacturing purposes. The landlord provides current for the halls, staircases, and lifts, and the tenants pay by meter for the current they use. This is, of course, precisely similar to the office block system in vogue in this country, but the point brought out is this, that where the supply company's discount varies with the amount used, this would be much greater on the total amount, if paid by the landlord, than on the smaller amounts paid by the tenants individually. In some cases, therefore, it would pay the landlord to pay the electricity bill for the whole building, and charge his tenants by meter at the central station rates.

Generally, however, it would pay him better to put down a plant and charge the tenants by meter. In most cases he could afford to charge from 10 per cent. to 25 per cent. less than central station rates, and still make a profit.

We are promised a further contribution on the subject, when the discussion of buildings used for residential purposes will be taken up.

Since Mr. Kapp's Society of Arts paper, there does not appear to have been any serious attempt made to collect and publish data referring to the costs of production in isolated installations in this country. The figures in his paper will, however, probably still hold good, as the cost per unit in a private installation does not fluctuate as in the case of a central station, owing to load factor. This is fixed from the start, unless, indeed, the plant is put in large enough to allow for considerable additions to the installation. Assuming, for the purposes of comparison, that the costs have not been reduced in the meantime, let us see how these compare with central station charges.

The London G.P.O. plant at that time had a capacity of 250 KW., with a maximum load of 190 KW. Total output per annum was 660,473 units, at a total cost of 2·475d. per unit, including 8 per cent. for interest and depreciation. This is considerably less than the average central station cost in 1895, and is below the City of London costs to-day. If taken from a supply company at an average price of 4½d. per unit, it would cost the P.O. over £5,500 a year more than with their own plant. If supplied on the maximum demand system at 8d. and 2d., the difference is only about £425 in favour of the private plant. But the supply company would only make £570 on a Bill of £7,200, or less than 8 per cent. margin to cover all standing charges and profit.

At the Savings Bank, with a 100-KW. plant, maximum load 50 KW., annual output 48,427 units, the total costs on the same basis were 3·428d. per unit.

At Tussaud's, with a 40-KW. plant, maximum load 32 KW., annual output 72,224 units, the total costs were 3·4d. per unit.

In all these cases, then, apart from the advantages of

finding a place free from stream lines—an ideal position for a magnetic laboratory if the conditions were realised in fact than those at less depths, and this line of reasoning

being independent of any outside company, there is a considerable saving shown on the home-made current.

The most remarkable result given was that of Messrs. Bainbridge & Co., of Newcastle. With a gas-engine plant of 50-KW. capacity, run practically up to the hilt, as the maximum load was 45·6 KW., the total costs were 1·855d., with an output of 50,850 units per annum.

The present price of electricity in Newcastle is 4½d.; but, even if the supply company would sell at 3·855d., this would mean a loss to the consumer of about £420 a year.

The above are comparatively large installations; that is, above the 500-light limit mentioned at the commencement of this article, but, under certain conditions, it can be shown that installations on a very much smaller scale can be economically worked from a privately-owned plant.

The consideration of such cases may be left over until we deal with Mr.-Parsons' second article.

COMPANY AND CONSUMER.

We published last week the report of the case of Husey *v.* London Electric Supply Corporation, Limited, heard recently by Mr. Justice Kekewich in the Chancery Division (see the ELECTRICAL REVIEW, January 31st, 1902), which has since been considered in the Court of Appeal. It raised a very interesting point in connection with the recovery of charges by an electric lighting company. Owing to change of tenants upon premises where electricity is supplied, the list of consumers is subjected to continual alteration. In addition to this, the difficulties of the supply company are by no means lessened by the unfortunate habit evinced by some consumers of vacating premises without paying their debts. In these circumstances, supply companies very naturally seek to obtain payment before they grant a supply to a fresh tenant. The result of an attempt of this kind is well illustrated by the case under notice, the facts of which were shortly as follows:—The London Electric Supply Corporation had for some time supplied electricity upon the usual terms to the St. Ermin's Hotel, Westminster. Until a short while ago, this hotel was in the occupation of the Mansions Proprietary, Limited, who, on January 17th, 1902, owed the supply company a large sum in respect of energy supplied. On that date, a Receiver, appointed by the Court of Chancery on behalf of the debenture holders, entered into possession of the premises. The supply company demanded payment of the debt in question, and threatened to switch off the supply unless the debt was discharged. In consequence of this the Receiver applied to Mr. Justice Kekewich claiming an injunction to restrain the supply company from refusing to give him a supply. Mr. Justice Kekewich granted the injunction, saying that in his view the company had no right to resort to such means. He apparently based his judgment upon the fact that the Receiver was a new tenant who could not be held responsible to the company for the liabilities of the outgoing tenant.

It is interesting, and not altogether unprofitable, to inquire into the reasons which led the learned judge to come to this conclusion.

The circumstances under which a supply company are entitled to cut off the current from a consumer's premises are set forth in the Electric Lighting Act, 1882 (45 and 46 Vict. c. 56 Sec. 21), which provides that if any local authority, company, or person neglect to pay any charge for electricity or any other sum due from *them* to the undertakers in respect of the supply of electricity to such local authority, company, or person, the undertakers may cut off such supply, and for that purpose may cut or disconnect any electric line or other work through which electricity may be supplied, and may, until such charge or other sum, together with any expenses incurred by the undertakers in cutting off such supply of electricity as aforesaid, are fully paid, but no longer, discontinue the supply of electricity to such local authority, company, or person.

It is clear that this section has no application to the case under review, if it be certain that the Receiver, on behalf of the debenture holders, does not stand in the shoes of the company itself. This is, in reality, the vital point in the case, for the Gas Works Clauses Act, 1871 (34 and 35 Vict. c. 41, S. 39), which is incorporated with the Electric Lighting Acts, provides that, in case any consumer of gas supplied by the undertakers leaves the premises where such gas has been supplied by him, without paying the gas rent or meter rent due from him, the undertakers shall not be entitled to require from the next tenant of such premises the payment of the arrears left unpaid by the former tenant, unless such incoming tenant has undertaken with the former tenant to pay or exonerate him from the payment of such arrears. If, then, the London Electric Supply Corporation can establish that the plaintiff in the case under notice is not a new tenant, but that, in his capacity as Receiver, he occupies the premises in question on behalf of the company, we anticipate that they will not be affected by the above provision. The view that a Receiver is a new tenant does not appear to us to be in accordance with the authorities.

In the case of Paterson *v.* the Gas Light and Coke Company, Limited (1896), 2 Ch. 476), a gas company, under Sec. 16 of the Gas Works Clauses Act, 1847, had power to stop gas from entering the premises of persons who had been supplied with gas and who had neglected to pay for the rent due for it. Under Sec. 18 of its private Act of 1872, in case any consumer should leave the premises where gas had been supplied to him without paying the rent due to the company, the company could not require from the next tenant payment of the arrears unless (*inter alia*) the incoming tenant should continue the trade or business of the outgoing tenant, and should have paid a consideration for so doing. A mill company had been supplied with gas on their premises, and owed to the gas company arrears of rent. The plaintiffs were appointed by the Court receivers and managers of the business of the mill company on behalf of debenture holders, who entered into possession of the premises and carried on business there. It was decided that whether or not the plaintiffs were occupiers of the premises so as to have the right themselves, apart from the mill company, to require a supply of gas, the gas company had a right to refuse to give it until the arrears of rent were paid. Lord Lindley, in the course of his judgment, said:—"Receivers and managers on behalf of debenture holders, whether appointed under a deed or by the Court, are in the position of caretakers as regards the mortgagor company, and their entering on the premises makes no change of possession. The plaintiffs therefore are not incoming tenants within the meaning of Sec. 18 of the Act of 1872, and that section was not applicable to the case."

It is difficult to see how Mr. Justice Kekewich differentiated the above case from that of Mr. Husey. He seems to have been in the position of a Receiver on behalf of the debenture holders, and apparently carries on the same business as had been previously carried on in the hotel. Further, it seems somewhat arbitrary to restrain a company from refusing to supply electricity, an injunction of that kind being, in effect, a mandatory injunction ordering the company to grant a supply. The above view was accepted in the Court of Appeal, the Lords Justices saying that whether the old contract continued, or there was a change of occupation, the defendant Corporation ought not to have been restrained from cutting off the supply of electric light. The appeal was, therefore, allowed, the injunction was discharged, the motion was dismissed with costs, and the respondents were ordered to pay the costs of the appeal.

CORRESPONDENCE.

A Perfect Wheatstone Bridge.

Opinions will differ as to what constitutes a perfect Wheatstone bridge, but, leaving aside the arrangement of the plugs, if we have a bridge that will give accurate values without any calculation over the ordinary range of temperature, and if, moreover, we are able to use the bridge for B.A. or standard units in an equally simple manner, and, what is more, if our old bridges will do these things without any change in their construction, we shall have arrived at per-

time covered by the figures, they do not teach us very much.

annual output 72,224 units, the total costs were 3·4d. per unit.

In all these cases, then, apart from the advantages of

fection, I think. There are thousands of bridges in use to which these remarks apply.

For some time I have used a bridge doing these things, and the more I use it the more does its value appear.

In the bridges as hitherto made, the wire in each coil of the arms and variable resistance is made of the same alloy, so that it shall vary uniformly, and may be approximately corrected by observing the temperature of the coils. If, however, we make the coils in the arm, A, of the bridge, that is, the set of ratio coils on the line side, of wire whose resistance does not vary through the ordinary range of temperatures, we shall have no occasion to observe the temperature of the coils. The bridge becomes self-correcting, whatever be the alloy, or metal, of which the coils are made, so long as they are all of the same material, and this for *any* ratio of the arms.

For the purpose I use a small box containing 10^{ω}, 100^{ω}, $1{,}000^{\omega}$, $10{,}000^{\omega}$ coils of manganin, this alloy having practically no temperature coefficient for the ordinary range of temperature.

There are several useful purposes which these extra coils may serve; for example, if they are adjusted to standard ohms, we can convert at once, a bridge in B.A. units, into standard units, and if these coils are adjusted for B.A. units, we can convert a standard units bridge into B.A. units. Again the range of the bridge is greater, since we can have ratios of $2{,}000^{\omega}$ to $1{,}000^{\omega}$, &c. Also, the resistance available in D can be increased by at least $1{,}110^{\omega}$. A further advantage is that the two arms of the ordinary bridge can be compared and verified, and the bridge with its own arms can at all times be compared and checked with the manganin coils.

The value of these points at cable stations and on board cable ships will, I think, be especially appreciated.

Jno. Gott.

The Testing and Management of Electric Motors.

I should like to express my entire agreement with your editorial remarks on this matter, except that while it is all very well to say that a motor which will not stand breaking its shunt is no class, there are many cases where motors, having their insulation thoroughly sound when sent out from the factory, have got damp in time (you can talk to some people till you are tired, about keeping motors clean and dry), and while the insulation still remains sufficient for its circuit, breaking the shunt is likely to pierce the insulation in an awkward place; this danger arises when the resistance between a field coil and frame is of the order of $\frac{1}{4}$ megohm, say, of a 20-H.P. motor. On proceeding to test a machine, the first thing to do is to ascertain the present value of the various insulations by any convenient method (Evershed ohmmeter, voltmeter, or galvanometer). To break the shunt circuit must be regarded as *bad advice*. No one who has had anything to do with motors or magnets of any kind should be without a small compass needle; a good one can be got for less than 1s., in a case of about the diameter of this coin, and perhaps $\frac{1}{4}$-in. thick; the representative of the supply authority may reasonably be expected to be acquainted with the main principles of the magnetic circuit. However, likely enough, there is much less danger in breaking the shunt of modern multipolar machines than in the case of the heavy wrought-iron magnets of the Kapp bipolar pattern, because the E.M.F. is more split up, and the insulation, perhaps, disposed in a superior manner.

The simplest way to avoid movement of the armature when trying the shunt, may be to rock the brushes into the position of minimum torque, so that the armature will not move when the starter is on the first stop, or better, follow the advice to remove "armature main," *but* fail not to connect it up again through a glow lamp or other resistance. There is something the matter with hint No. 8; surely the writer means gramme where he says drum. I have known many a gramme ring armature run with a short in it, but never a drum. Almost any armature suffering from a disconnection in the winding will run with periodic flashing at the commutator indicating a break. Of course, the field connections of a machine must be interrupted, preferably at both electrodes, when mechanically driving it for the purpose of truing the commutator. If anyone wants instances of motors breaking down through the disruptive E.M.F. made on breaking the shunt, ask the people who supplied a couple of dozen or more motors to the ——— Bridge Building Works. In some places it has been the practice to keep the shunts always on to the dynamo, whether the motor is working or not; but this wasteful precaution is unnecessary, now that proper starting switches for shunt motors can be obtained.

In conclusion, attention might be called to an article that went through the *Mechanical Engineer*, of Manchester, for March, 1900, where some notes on the practical testing of machines are to be found.

N. C. W.

Is Visions About?

The other day a consulting engineer visited my station, and, catching sight of a "hedgehog" transformer, he astounded me by asking, "What is the *tasis* of that obsolete apparatus, and what its *posot?*"

As a reader of the Electrical Review for many years past, I would ask you, Sirs, what the gentleman wished me to understand by such an extraordinary inquiry; and why should a "hedgehog" give rise to it?

Shift Engineer.

[We expect the consulting engineer had been reading Mr. Swinburne's humorous lecture before the Physical Society, in conjunction with the leading article which appeared the following week in an esteemed contemporary.

It is only physicists who find Mr. Swinburne's paper difficult to understand, for his factors are not only analogous to those used in electricity, but also to those used in other branches of physics. For instance, the conduction of heat is merely the flow of *posot* down *tasis!* Conductivity of *posot* follows Ohm's law, and the capacity of a body for *posot* is constant.

"A conductor," says our contemporary, "at any given difference of electric potential conveys a current proportional to that potential difference; and a conductor at any given difference of *tasis* transmits *posot* proportional to that difference."

Mr. Swinburne defines heat energy as *posot* in a condition of *tasis*. "But what," asks our contemporary, "is *posot?*" We can only refer such queries to Mr. Macfarlane Gray, who seems to have found some "although undisclosed."

We hope "Shift Engineer" is satisfied with this very simple explanation, although, as Mr. Swinburne confesses, it is "not very easy to express in words, and would be still more difficult to express mathematically."—Eds. Elec. Rev.]

Jointless Car Cables, Patent No. 12,862.

I notice in your last issue of February 7th a letter from Mr. L. D. Collins criticising my patent. He evidently is not in full possession of the particulars of this jointless cable, nor has he compared the system suggested with the one he calls his own. It is evident that he has not understood the idea of the invention.

His system, which consists in simply pulling out a loop from one of the cables in the hose, is, as he mentions, too simple to patent, and, I would suggest, an exceedingly bad one to use. By simply pulling out this loop twice the cross-section of the cable necessary for conveying the current is uncovered at the point where it is most liable to injury.

In my system the exposed section is made up of one cable looped of half the cross-section of that necessary to carry the current, which gives it greater flexibility.

Mr. Collins happens to be entirely wrong as regards his remarks of a theorist's work, as it is the wiring of hundreds of cars which first gave the idea of the patent.

I may mention that the jointless car cable has been favourably criticised by the best consulting engineers, and amongst the other great advantages claimed for it is the

under review, if it be certain that the Receiver, on behalf of the debenture holders, does not stand in the shoes of the

of standard units in an equally simple manner, and, what is more, if our old bridges will do these things without any change in their construction, we shall have arrived at per-

fact that it can be produced at a cheaper rate than the car cables which are generally used at the present day.

The Patentee.

London, *February 11th*, 1902.

Soldering Fluids.

We notice in your last issue a letter from some soap-makers claiming to be the makers of the Burnley soldering paste. They are, however, mistaken, and we shall be glad if you will insert this letter.

We do not know what the paste is they are making, as we have never heard of it before, but it certainly is not Burnley's rozinal soldering paste, which is an American patented product, and is so called from the name of the inventor. As "H. F. T." states, it had been used for seven or 10 years in America previous to its introduction by us into this country. During the whole of this time the inventor has been striving to overcome all objectionable features, and we think he has succeeded. With regard to your correspondent's query, we may say that amongst an enormous list of users we are supplying some of the largest cable-makers, and it is quite suitable for use on insulated wires as well as for all soldering work.

We are the sole selling agents for England and Europe.

Beanland, Perkin & Co.

LEGAL.

Gibbs *v.* Chloride Electrical Storage Company, Limited.

Judgment was given in this case on Thursday last week.

The Master of the Rolls said there was no dispute as to the fact that the defendants owed the price of the sulphuric acid, and the whole question turned on the counterclaim. Plaintiffs strenuously denied that there was any hydrochloric acid in the sulphuric acid, and that issue, to some extent, obscured the other issue, which turned out in the end to be the really important one, namely, whether, taking it that hydrochloric acid was present, it caused the damage which was alleged to have been occasioned to the batteries. The point as to whether the sulphuric acid contained hydrochloric acid was decided by the learned judge against the plaintiffs. It was quite clear that the sulphuric acid delivered by the plaintiffs was uniform in the sense that it contained a percentage of ·25 of hydrochloric acid. Then came the question as to what the effect of this was on the defendants' batteries. One party named Edmundson had taken a contract to make an electric installation in a house at Drayton Park, and Edmundson contracted with the defendants for the supply of the electric storage batteries, consisting of 51 cells. In order to set these batteries in action, Edmundson used the sulphuric acid supplied by the plaintiffs, and at once there was evidence of the presence of the hydrochloric acid. The fumes given off were so strong that the men who had to conduct the operations were obliged to stop working for a time. Under these circumstances there was no doubt that the managing director of the defendant company was very strongly impressed with the fact that irreparable injury had been done to the batteries, but though he wrote a letter to that effect, he pursued the installation and the battery was placed in action and subjected to tests. It was found that the battery fell short of the contracted standard, but there were two reports made by the defendants' engineer, which were very important, because the case for the syndicate was that immediately upon the first contact of hydrochloric acid with the plates in the cells irretrievable damage was done. The installation took place about the middle of December, and these reports which were made in February and March did not support the contention that the cells were completely destroyed. Five-sixths of the cells were found quite up to the standard. As it was said the battery was deficient in power, another battery was substituted for it. Perfectly pure sulphuric acid was used in connection with that battery, but it was found that the second battery also fell short of the standard, and it had to be strengthened by fresh cells. In July the first battery was broken up and destroyed, and it was very unfortunate that when this battery was taken back to the defendants' works it was not submitted to tests and experiments by experts. The case had, therefore, to be dealt with in the absence of such evidence. The burden was undoubtedly on the syndicate to show that the hydrochloric acid destroyed the batteries. It was suggested by the plaintiffs that the mischief was in the cells and not in the acid. The differences which were shown in the cells were not against the theory that the mischief was not due to one uniform cause, but that the plates themselves were to blame for the deficiency in the strength of the batteries. As the burden was on the syndicate of proving that the plates had been destroyed by the acid, and as there was not sufficient evidence to establish this fact, he thought Mr. Justice Bigham had taken a perfectly sound view of the case, and the appeal would accordingly be dismissed.

Lords Justices Romer and Mathew concurred.

The London Electric Supply Corporation *v.* Davis.

In the Chancery Division on Friday last, before Mr. Justice Kekewich, Mr. Cartmell said he had a motion in the matter of the London Electric Supply Corporation *v.* Davis, the object of which was to restrain the defendant from taking electric energy from any other company or persons in breach of an agreement he had entered into with the plaintiffs. Mr. Clayton appeared on the other side, and had consented to an injunction in the terms of the notice of motion, the motion to be treated as the trial of the action. His Lordship made an order upon the terms agreed.

New Brotherton Tube Company *v.* Isaacs, Griffiths & Sons.

Last week in the Court of Appeal, consisting of the Master of the Rolls, and Lords Justices Romer and Mathew, the appeal of the plaintiffs in this case—for an injunction restraining the defendants from copying their catalogue of enamelled steel tubes—from a decision of Mr. Justice Jelf refusing to grant such injunction, was disposed of.

Mr. C. H. Smith (with him Mr. D. Woodcock), for the appellants, said his clients were prepared to accept the hearing of the appeal as a trial of the action. The defendants had copied the plaintiffs' trade catalogue, inserting in their own the same blocks and prices even as were contained in the plaintiffs, although the book was registered at Stationers' Hall. The production of the catalogue put the plaintiffs to a great expense, therefore, as there had been an infringement of the plaintiffs' copyright, the learned Judge should have granted the injunction.

Mr. Disturnal, for the respondents, said that the infringement complained of was a case of the *de minimus* order. The defendants had agreed to a perpetual injunction on certain terms which he had suggested in reference to the infringement complained of.

The plaintiffs' counsel then said that if the defendants brought out a second catalogue, another action for infringement would be instituted against them. Thereupon they declined to adhere to the terms they had offered.

The learned Judge thereupon refused the injunction.

The Master of the Rolls, in giving judgment, said he thought that the mind of the learned Judge below had been somewhat coloured by what had been stated in the course of the arguments, and especially by the offer made on behalf of the defendants. The Court must differ from the order made refusing an injunction in a case which was clearly one of infringement of plaintiffs' copyright in their business catalogue. The injunction asked for in regard to two catalogues would be allowed, with costs there, and in the Court below.

Lords Justices Romer and Mathew concurred.

Husey *v.* The London Electric Supply Corporation.

In the Court of Appeal, composed of Lords Justices Vaughan-Williams, Stirling, and Cozens-Hardy, on Wednesday last week, the case of Husey *v.* The London Electric Supply Corporation came on for hearing on the appeal of the defendants in the action from an order of Mr. Justice Kekewich restraining them from cutting off the supply of electric energy to St. Ermin's Hotel, Westminster. The Mansions Proprietary, Limited, were the owners of the hotel, and they issued "A" debenture stock to the amount of £75,000. The defendants supplied the company with electric light under an agreement which gave the company the power to discontinue the supply if the consumer should make default in payment of the amount due from the Mansions Company. The plaintiff had been appointed receiver and manager of the hotel on behalf of debenture holders, and on defendants threatening to cut off the supply of electricity if the arrears remained unpaid, plaintiff obtained an *ex parte* injunction. Mr. Justice Kekewich held that, although the plaintiff must make a fresh application for a supply, the defendants must be restrained until the application was made. Defendants contended that this was a hardship on them because, if the supply was cut off, they would be at once paid. Plaintiff's submission was that he was not bound by the old agreement, because he was a new owner and occupier, but, as a rejoinder, defendants put forward a case in which it was held by the Court of Appeal that a receiver was a mere caretaker. Mr. Laurence, K.C., and Mr. Cartmell appeared for the appellants, and Mr. Warrington, K.C., and Mr. Mitchell for the respondent.

At the conclusion of the arguments of counsel, Lord Justice Vaughan-Williams, in giving judgment, said he would assume that there was a new occupation by the plaintiff as Receiver, and that the occupation of the Mansions Proprietary, Limited, had come to an end. That was the contention of the plaintiff, which put him in the best position. His Lordship's opinion was that even if the contention was correct, the Receiver was not entitled to any supply of electric lighting unless and until he made a new contract with the defendant corporation. If one had to suppose that the old contract between the defendants and the Mansions Proprietary, Limited, continued, there could be no doubt that the defendant corporation were entitled to cut off the supply of electricity, because of the default made in payment of the account by the Mansions Proprietary, Limited. Under those circumstances, it seemed to his Lordship that whichever way it was put, it was not right to grant the injunction restraining the defendants from cutting off the electricity. His opinion was that the Receiver was not entitled to any supply of electricity unless and until he had made a contract with the defendant corporation for that supply, and as

he had not made that contract, he was not entitled to restrain the defendants from cutting off the supply.

The other Lords Justices concurred, and the appeal accordingly was allowed, the injunction granted by Mr. Justice Kekewich being discharged, the respondent being directed to pay the costs in the Court below and of the appeal.

Lord Justice Vaughan-Williams advised counsel for the respondent to treat the motion as the trial of action, but the learned gentleman said his client was not in Court, and he should not like to take the responsibility of consenting to that course in his absence.

Rattee *v.* The Norwich Electric Tramway Company, Limited.

In the Court of Appeal, consisting of the Master of the Rolls and Lords Justices Romer and Mathew, Mr. F. Low, on behalf of the defendant company, moved on Thursday last week for a stay of execution in this case, which was heard before Mr. Justice Grantham and a jury at the Norwich Assizes, and which resulted in a verdict for the plaintiff for £850 damages. The learned Judge refused to grant the stay, and as the defendants intended to appeal they now made this application. The action was brought to recover damages for personal injuries sustained by the plaintiff, a veterinary surgeon, as alleged, through the negligence of one of the defendants' servants, and the question, the learned counsel remarked, was one of considerable importance to tramway companies in general. It was not disputed that the action was brought about by the plaintiff's horse taking fright, but it was said that the animal was scared by the defendants' driver not stopping the car or by the bell or gong which these cars have to carry. On the conclusion of the plaintiff's evidence, he (the learned counsel) submitted that there was no case of negligence on the part of the driver, but the learned Judge allowed the matter to go to the jury, with the result that a verdict was given for the plaintiff. The ground of the present application was that if the damages were handed over to the plaintiff and the defendants were successful on appeal, there would be little chance of their recovering the money. Plaintiff had no assistance in his business, and he resided in a small village outside Norwich, the rateable value of his house being £17, and that of a piece of land adjoining £16. The defendants were quite willing to bring the £850 into Court and to pay over the costs to the plaintiff on the usual undertaking that they be returned in the event of the appeal being successful.

The Master of the Rolls said the defendants might have the stay on bringing the amount of damages into Court, the costs of the trial to be paid over to the plaintiff's solicitor on the usual undertaking. It was understood that the appeal would be entered at once by defendants.

In *re* The Charing Cross and Strand Electricity Supply Corporation, Limited.

In the King's Bench Division last week, before the Lord Chief Justice and Mr. Justice Ridley, Mr. Daldy moved for a rule nisi calling upon one of the aldermen sitting at the Guildhall Justice Room to show cause why a mandamus should not issue commanding him to state a case for the opinion of this Court. The applicants, the Charing Cross and Strand Electricity Corporation, Limited, were summoned before the alderman for not giving notice to the district surveyor, under Section 200 of the London Building Act of 1894, of their beginning to execute a work which it was said was a structure or erection within the meaning of the statute of which notice should be given. The work in question was a street inspection box, which was merely an enlargement of the pipe or conduit along which the cable was carried, and the learned counsel said that if it was held to come within the Act, then the whole conduit pipe might be said to do so. The Alderman, however, held that the offence was proved, fined the Supply Corporation 40s. and costs, and refused to state a case raising the question of law.

A rule nisi was granted.

BUSINESS NOTES.

Electric Pinnace for Natal.—The Thames Valley Launch Company, Limited, have just secured an order from the Natal Government for a 32 ft. electric pinnace. The boat is designed to run a considerable distance at a good speed, and for use in rough water. She will be fitted with patent gear (W. Rowland Edwards's patent), by which one wheel for lever switches on the current and regulates everything, including steering. Great mechanical advantages are said to be obtained by this invention, which will be exhibited at the Boating Exhibition which opens at Earl's Court on March 1st. The accumulators will be fitted with patent non-corrodible connectors, making a perfectly acid proof joint. The company have also secured an order for an electric launch for Naples, and five others, electric and petrol, for use on the Thames, including a 45 ft. boat for a private owner. They have also on hand some additions to their own fleet of letting-out boats which will then number over 40 vessels.

Electrical Wares Exported.

Week ending Feb. 12th, 1901.		Week ending Feb. 11th, 1902.	
Adelaide	Value £150	Alexandria	Value £42
Boca. Teleg. mat.	189	Amsterdam	50
Bombay	120	Beira	53
Bremen	63	Bombay	33
Buenos Ayres	1,479	Buenos Ayres	309
,, Teleg. mat. ..	523	,, Teleg. cable ..	275
,, Teleph fittings	1,150	Calcutta	655
Calcutta	669	,, Teleg. mat.	150
Cape Town	981	,, Teleg. wire	59
,, Teleg. mat. ..	1,269	Cape Town	482
,, Teleg. cable ..	180	Channel Islands	294
Colombo	20	Chinde	28
Copenhagen	88	Colombo. Teleg. mat.	245
Demerara	561	Copenhagen. Teleg. wire ..	116
Durban	260	Durban	1,211
East London	8	East London	96
Gibraltar	19	Gibraltar	15
Madras	48	,, Teleg. mat.	35
Melbourne	409	Hamburg	40
Monte Video. Teleg. mat. ..	100	Hobart. Teleg. mat.	36
Port Elizabeth	142	Hong Kong	90
Rio Janeiro	13	Lisbon	50
Shanghai	122	Melbourne	500
,, 23 tons old cable wire	—	Otago	120
Sydney	460	Perth	140
Trieste. Teleg. cable	645	Port Elizabeth	510
		Rosario. Teleg. mat.	828
		,, Teleg wire	7,800
		Shanghai	42
		Singapore	776
		Suez. Teleg. mat.	144
		Sydney	134
		Wellington	94
		,, Teleg. mat.	659
		Yokohama	3,922
Total ..	£9,602	Total ..	£19,910

Foreign Goods Transhipped.

Brisbane. Elec. goods.	Value £89	Colombo. Elec. Cable	Value £38
Gothenburg. Elec. mat. ..	10	Durban. Teleph. wire	308
Perth. Elec. goods	1,509		
Total	£1,558	Total	£346

Cable Calculator.—From Messrs. Isidor Frankenburg, Limited, of Salford, we have received a very handy "Cable Calculator," by means of which it is possible to easily and accurately calculate the cost of any length of any size, or class of wire and cable, whose listed price is between £15 and £650 per mile. In regard to the method of using the "Calculator," it is only necessary to place the price per mile—which will be found on one or other of the sides of the inner slide—opposite the required length (as given at the upper, or lower, edges of the opening in the outside cover); and the gross price for such length will be found between the short black lines at either of the two upper, or lower, windows, according as the length needed is on the upper, or lower, edge of the opening. This "Calculator" will be of service to engineers in making calculations for estimates and tenders.

Manchester Switchgear.—One of the largest switchboards contracts has recently been placed with Messrs. Ferranti, of Hollinwood, by the Manchester Corporation. This contract includes a switching gear for a capacity of 12,000 H.P. to be generated at the new Stuart Street Station; and it also includes complete high and low tension equipment for 10 sub-stations, which are to contain motor-generators for traction and lighting loads. The whole is to be delivered complete in nine months. This is a typical example of the progress made in this country by large contractors. Messrs. Ferranti's, anticipating a large demand in the future for their well-known apparatus, are equipping an extensive building with the latest machinery, and by introduction of the most approved methods of production, will be in a position to meet any calls for switchgear required by power transmission and distribution schemes. Their new building will be large enough to engage over 500 men. It is expected that this new factory will be in complete working order within six weeks. It is with satisfaction that we note that the switchgear industry in this country is being dealt with in a way that will ensure economical production, and will maintain the supremacy in design, which has hitherto been the characteristic of British production.

May-Oatway Apparatus on the Liverpool Overhead.—The Dingle Station on the Liverpool Overhead Railway, which was damaged by the serious fire on December 23rd last, was reopened for traffic on Monday. The station has been supplied with the May-Oatway automatic fire alarm. On Saturday afternoon last the fire alarm system was subjected to experimental tests in the presence of a party of representatives of insurance and industrial companies, among them being Messrs. E. J. Hidden (National Telephone Company), and J. W. Cooper (British Westinghouse Company), the party forming a committee of investigation. Before beginning the tests, Mr. S. B. Cottrell, general manager of the Overhead Railway, stated that the desire of the patentees of the fire-detecting apparatus and of the directors of the Overhead Railway Company was to demonstrate that the system worked satisfactorily, and for that purpose an independent committee had been appointed to inspect the apparatus. Test fires were then lighted in a signal box and at the Park Road entrance to the station. In each case the alarm worked promptly. In a few seconds the fire signals were operated, and the indicators showed the place of the outbreak. A full equipment of fire-extinguishing apparatus has been supplied by Mr. B. Richard Isaac, Liverpool. The station has been refitted as far as was necessary, and is lighted both by electricity and incandescent gas lamps.

Acetylene Gas for Power.—A series of tests were made on January 29th at the offices of the Acetylene Stores, Limited, under the direction of Mr. Stephen Earl, with a new apparatus for using acetylene gas. We are informed that acetylene will not burn in a Bunsen burner, but will produce smoke. In the tests named, acetylene gas generated from carbide was carried through vessels containing liquid hydrocarbon, the nature of which was not stated, and we can only surmise it to be one of the petroleum extracts that has the power of mixing with acetylene. The generator is of the holder type with two retort boxes for continuous working. The acetylene generated can be used in the ordinary manner if desired, or it can be led through the carburettor and burned as a blue Bunsen flame for heat or, with the addition of a mantle, for light. The flame, as seen by us, was a perfectly blue Bunsen flame, and the light given by the mantle—Voelker's mantle was used—was clear and smokeless. It is also claimed that the mixture, be it a mechanical or a chemical union of the acetylene with the hydrocarbon, can be employed in the gas engine with good results. Thus, the system is specially suitable either for incandescent lighting or for gas-generated electric lighting. The new system caused considerable interest to those present at the test, and we understand that the owning syndicate are laying down plant at their works at Hackney to manufacture generators and carburettors under their patents in order to put their apparatus on the market.

Bankruptcy Proceedings.—At Exeter Bankruptcy Court on Friday, Mr. H. G. Massingham, formerly an electrical engineer at Bath, Taunton and Exeter, who had also been connected with some large boot companies at Exeter, Taunton, and Torquay, applied for his discharge from bankruptcy. Mr. Clarke (Taunton) appeared for the debtor. The Official Receiver's report showed that the debtor's assets were not sufficient to pay 10s. in the £, that he had omitted to keep proper books of accounts, and had continued trading after knowing himself to be insolvent. His conduct during the proceedings had been satisfactory. Mr. Clarke applied for the debtor's discharge to be suspended for as long as his Honour (Judge Lush Wilson) thought fit. Mr. Massingham was practically one of the pioneers of electic lighting in the West, but, unfortunately, he had not the exclusive privileges which Corporations were likely to get, with the result that someone else had got the advantage of the undertakings. He considered that no less than from £10,000 to £11,000 losses were accounted for in that manner. With reference to the majority of the liabilities in this matter, they were liabilities which he had incurred on behalf of the West of England Boot and Shoe Co., of which he was managing director, and of which he had, unfortunately, taken the responsibility. The debenture holders had taken possession, and finding that he was liable for these amounts, he had filed his petition. His personal liabilities were small—in fact, almost infinitesimally small. It seemed a case of misfortune, and he asked his Honour to grant the discharge, but to suspend it for a period of two years to enable the debtor to make a fresh start in life. His Honour said that as far as he could judge from the report, the debtor had certainly not appeared intentionally to have committed any offence against the Bankruptcy Act, although he had undoubtedly committed one or two of the offences as to trading and incurring debts while insolvent, and in not keeping the books which should have been kept. He could not help saying debtor worked very hard in pushing forward the electric light business, but others had reaped the benefit of his exertions; but he thought debtor had shown a certain amount of rashness in business, and no doubt the creditors had suffered. He felt the justice of the case would be met, so far as the Bankruptcy Act was concerned, if the discharge was suspended for two years. He granted the application subject to that condition.

Herbert Cooke, 12, George Street, Parade, Birmingham, electrical engineer, has been adjudicated bankrupt at the Birmingham County Court.

Dissolutions and Liquidations.—At meetings held on January 20th and February 5th the shareholders of Allan and Adamson, Limited, resolved to wind up voluntarily with Mr. W. Peto, of 55, Hatton Garden, E.C., as liquidator. The liquidator was authorised to register a new company to be named Peto and Radford and Allan Accumulator Manufacturing Company, Limited, to which all the undertaking and assets of Allan & Adamson will be transferred. Draft agreements under which this is to be carried into effect were approved by the meetings.

A meeting of the London Electric Omnibus Company is announced for March 13th at 64, Gresham Street, E.C. (offices of P. Mason and Co.), to hear an account of the winding-up from the liquidator, Mr. P. Mason.

Messrs. F. E. Stephens and T. Martin, ironmongers and electrical engineers, &c., of Bideford, have dissolved partnership. Mr. Stephens attends to debts and carries on the business.

Creditors of Allan & Adamson, Limited, must send particulars of debts, &c., to Mr. Peto, by March 12th.

A meeting of the Leecoll Electric Battery Company is to be held on April 9th, at 14, Devonshire Square, E.C., to hear an account of the liquidation proceedings from Mr. S. A. Cobbett.

Messrs. W. Ward and H. Turner (Ward & Turner, electrical engineers, Stanningley) have dissolved partnership. Mr. Turner attends to debts.

Messrs. A. Markwell & W. F. Walton (Electric Light and Maintenance Company, Richmond Mansions, Putney), executed a deed of assignment last September, and all creditors should send their claims, &c., to the trustees, Mr. C. H. Robson, 71, Queen Victoria Street, E.C., by February 28th.

Messrs. W. Mossop & J. A. Cross announce that the partnership hitherto existing between them in the Concentric and General Contract Company has now been dissolved by mutual consent. Mr. Walter Mossop will continue to carry on the business of this company as before at the same address, 52, Queen Victoria Street, E.C.

Books Received.—"Practical Calculation of Dynamo Electric Machines," by A. E. Wiener. New York: *Electrical World and Engineer*, 1902.

"A Travers la Matière et l'Energie," by Dr. F. E. Blaise. Paris: Ch. Delagrave. 12 fr.

Journal of the Institution of Electrical Engineers, No. 154, Vol. 31. London: E. & F. N. Spon, Limited. 4s.

"Grundriss des Elektrotechnik," by Heinrich Kratzert. No. 4. Electrochemie; No. 5. Elektrotechnik im Bergbau, in der Landwirtschaft und Schiffahrt. Leipzig and Wein: Franz Deuticke, 1902. Kr. 6 and Kr. 5 respectively.

Catalogues and Lists.—A handy little pocket calendar (1902) and directory of the cold storage and ice factory trades has been sent to us by the editors of the *Cold Storage and Ice Trades Review* (19, Ludgate Hill, E.C., 6d.).

Mr. G. Braulik, of Upper Thames Street, has brought out a new "up-to-date" price list of his "London" enclosed, Excelsior, and other arc lamps, also searchlights and projectors for photographic, theatrical, and medical work.

The Mica Insulator Company, Limited, of Empire Works, Stansted, Essex, has brought out a new catalogue showing the various types and sizes of standard micanite commutator rings, which it can supply from stock moulds.

The Lahmeyer Electrical Company, Limited, has issued a new illustrated price list (No. 13) describing its crane controllers. Diagrams of connections and illustrations and details as to methods of arranging and working are given. Pictures of travelling cranes (from 10 to 50 tons), also jib and foundry cranes, which have been supplied for different factories, and so on, are shown.

Pamphlet No. 117 of the B.T.H. Company is devoted to an illustrated description of air-blast transformers; No. 116 deals with type OK ampere-hour meter for c.c. circuits.

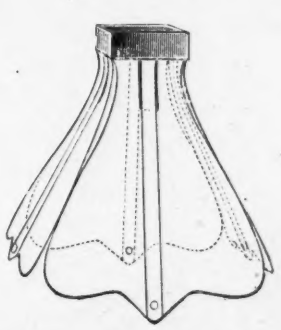
From Messrs. Francis & Spilsbury, of Bucklersbury, E.C., we have received a list of cranes manufactured by their principals, Messrs. Mohr & Federhaff, of Mannheim, Germany, for whom they are sole agents in the United Kingdom. Electrically-driven hoisting machinery for quays and railways, also electric travelling cranes are illustrated and described in the pamphlet.

The Lighting Corporation, Limited, of Bloomsbury Street, W.C., have placed before us priced lists of their Wenham enclosed arc lamp, incandescent electric lamps, and designs for Wenham coronation illuminations.

We have received a pamphlet from Messrs. Roberts Bros., of Dukinfield, near Manchester, illustrating their specialities in labour-saving machine tools, which include disc surface grinders, boring and turning mills, and capstan lathes. Their 18 in. "Universal" disc surface grinder was illustrated on p. 1083 of our last volume, in connection with our articles on machine tools at the Glasgow Exhibition.

Gateshead.—Messrs. F. Reid, Ferens, electrical engineers and steeplejacks, Orchard Street Buildings, Newcastle-on-Tyne, have secured the contract for taking down the large stone condenser at Messrs. Alhusen's works, Gateshead. This work comes under the steeplejack department, which at the present time has a good deal of business in hand.

Mica Reflector.—An ingenious device, called the Micaylorlite reflector, is being introduced by Messrs. Taylor & Co., of Hatton Garden. It is claimed that it casts no shadow, while it



reflects a considerable proportion of light, though these claims appear to be antagonistic. The reflector is shown in the figure, from which it will be seen that it is slipped over the neck of the lamp before insertion in the holder. As it consists solely of mica and brass, it is practically indestructible.

New Journal.—We have before us No. 1 of a new sixpenny monthly journal, published by the Foundry Publishing Company, of 182, Oxford Street, W. With the title, the *Foundry Trade Journal*, it will devote itself specially to the interest and advancement of the foundry trade, as foundrymen are said to have long felt the want of a good medium for the exchange of ideas and experiences, and the illustration of the improved methods that from time

to time are placed upon the market. One of the chief objects of the new journal is to advise foundry-masters of the best means of facilitating and improving the manufacture of castings of all descriptions. It emphasises the necessity for introducing radical improvements to meet foreign competition in the steel and iron industries. It strikes the right note in its opening number, and it seems to us that there is plenty of scope for such a paper.

Parliamentary.—The following Bills came before Mr. Campion, the Examiner, on Monday, for proof of compliance with Standing Orders of the House of Commons:—

Newcastle-on-Tyne Corporation Tramways Extension.—Under this Bill the Corporation of Newcastle-on-Tyne seek power to construct new tramways, in all 16 in number. The total length of the tramways is about 12 miles. For the most part the tramways will be outside the city, and the parishes affected are Walker, Wallsend, Benwell, Gosforth, and Weetslade. Section 17 provides that so long as the District Council of Walker is willing and able to supply electricity for working the trams, the Corporation shall not themselves supply it without the consent of the Council. It was decided to postpone the examination of the Bill till February 24th.

Halifax Corporation.—Standing Orders were found to have been complied with in the case of this Bill, particulars of the electrical portion of which were given in the ELECTRICAL REVIEW of January 31st.

Wrexham District Tramways (Extension).—It was found that Standing Orders had been proved in the case of this Bill, which empowers the Wrexham and District Electric Tramways, Limited, to construct new tramways, and to substitute 42 years for 21 years as the period for purchase by the local authorities.

Torquay and Paignton Tramways.—Notice of opposition has been given in the case of this Bill, particulars of which have already been given in the ELECTRICAL REVIEW. It was decided to postpone the examination till February 24th.

London County Council (Tramways and Improvements).—This Bill, which contains important tramway schemes promoted by the L.C.C., has already been before the Examiner of Standing Orders and approved, with the exception of the schemes relating to Wandsworth. On the Bill again coming before the Examiner it was decided to postpone the examination till February 24th.

Birmingham and Midland Tramways.—This is a Bill for sanctioning the Birmingham and Midland Tramways, Limited, to construct additional tramways. Land at Smethwick is scheduled for the erection of an electricity generating station. The company are the owners of the tramways near Birmingham. It is proposed to construct altogether 15 sections of tramway in the districts of Handsworth, Smethwick, Oldbury, and Rowley Regis. The examination was postponed till February 24th.

Scarborough Tramways.—The Examiner found that Standing Orders were proved in the case of the Scarborough Tramways Bill, details of which have already been given in the ELECTRICAL REVIEW. Shortly the proposal is to incorporate a company with a capital of £96,000, and the usual borrowing powers to lay down an electric tramway service for the borough.

Aberdeen Suburban Tramways.—Standing Orders in the case of this Bill were found to have been proved. Power is given to the tramway company to construct certain tramways and to enter into agreements with the Aberdeen Corporation in connection with running powers, &c.

The following Bills, which have before been mentioned in the ELECTRICAL REVIEW, came before the Examiner, and were postponed:—Hove, Worthing and District Tramways, and the South Shields, Sunderland and District Tramways, till February 17th; Exeter and District Tramways, Rossendale Valley Tramways, Mexborough and Swinton Tramways, Croydon and District Tramways, North Ormsby, South Bank, and Grangetown Tramways, and London United Tramways, till February 24th.

Smoke Troubles.—The Trafford Electric Power and Light Supply Company, and Messrs. W. T. Glover & Co., Limited, were both summoned at Manchester last week by the Stretford U.D.C. for smoke nuisance. For both parties it was said the Mond gas plant would be in working almost immediately, and no complaint would afterwards be made. The cases were adjourned for a month.

Trade Announcements.—With reference to the notice which appeared in our last issue regarding Messrs. Geipel & Lange, and the agency for Messrs. Chauvin & Arnoux, it is said that the statement "(as successors to Messrs. H. M. Salmony & Co.)" may convey a wrong impression. Messrs. Geipel have not succeeded to the business of Messrs. Salmony, but it was intended only to imply that Messrs. Chauvin & Arnoux had transferred their agency to Messrs. Geipel & Lange, as everybody in the electrical trades doubtless clearly understood.

The business of the Sheffield Electrical Engineering Company has been purchased, as from January 18th, by Mr. E. O. Burn, who will carry it on under the same name as before at the Dynamo Works, Napier Street, Sheffield. The company is laying down new plant, and will now be able to give prompt delivery. While continuing to make a speciality of dynamos for electro-plating, the company will also supply them for any other purpose.

Messrs. Clarke and Meldon have recently gone into partnership as electrical engineers at 16, Wicklow Street, Dublin. Mr. Clarke has been on the electrical staff of the Dublin United Tramways Company. Mr. Meldon has been several years with the same company, and has had charge of their sub-stations at different times.

The British and Foreign Electrical Vehicle Company has changed its name to the British Electromobile Company, and has removed its registered offices to 4, Bloomsbury Place, W.C., where the whole of the general business of the company will in future be conducted.

The name of the Safety Concentric Wiring Company, of Bovay Street, Holloway, has been changed to the Holloway Electric Supply Company, Limited, the directors having decided to confine the business of the company to the electricity supply station.

Messrs. Easton & Co., Limited, have appointed Mr. G. D. Seaton as their representative for the Midland counties, including Derby, Herefordshire, Leicester, Lincolnshire, Northampton, Nottingham, Shropshire, Staffordshire, Warwickshire and Worcester. Mr. Seaton's address is 36, Islington Row, Edgbaston, Birmingham.

Zschocke Cooling Towers.—Messrs. Doherty & Donat, who are the sole British agents for the Zschocke patent water-cooling towers, ask us to announce that, unless otherwise specified, their towers are made in England by English labour. They wish promptly to contradict reports which have been placed in circulation that the towers are made in Germany.

ELECTRIC LIGHT AND POWER NOTES.

Ballymahon.—A largely-attended meeting was held last week to consider the question of lighting the town by electricity. A company will be formed to raise the necessary capital, and advertisements will be issued at once inviting tenders from electrical engineers.

Bexley.—Messrs. Mordey & Dawbarn's report on electric lighting and tramways is before the U.D.C. They advise the Council that if matters are proceeded with at once the light can be available by next winter.

Bloemfontein.—The electric lighting of the town has proved a success, but the system is not at all adequate for the town's requirements. It is necessary to almost double the present plant at a cost estimated at £13,650.

Bognor.—A poll of the town took place recently in order to decide the question whether the U.D.C. should be empowered to raise a loan of £12,000 in order to defray the cost of electric lighting. The result of the voting was decidedly against the project, being as follows:—For the electric light, 93; against, 296; majority against, 203.

Coseley.—The Midland Electric Corporation for Power Distribution, Limited, have made an offer to supply the U.D.C. with electricity for lighting purposes. They state that the charge for public lighting during 3,600 hours per annum for each 25-C.P. lamp would be £2 18s. 6d.; for each arc lamp equal to 2,000-C.P. nominal, the local authority providing all capital expenditure and the company the current, carbon, &c., the cost would be £16 10s.

Derby.—The T.C. has passed a vote of £8,000, the estimate of expenditure on capital account for the present year. Of this sum £6,000 is for mains, services, &c.

Dublin.—On Monday the Lord Mayor of Dublin, in presence of the Lighting Committee and officials of the Corporation, laid the foundation stone of the new electric works at the Pigeon House Fort, and expressed the hope that the new scheme would be a great success. Lunch followed, at which speeches suitable to the occasion were made.

Elland.—The U.D.C. is about to advertise for tenders for the machinery for an electric lighting installation. This week a L.G.B. inspector has held an inquiry into an application for sanction to borrow £16,000 for the purpose.

Farnham.—Having heard from its advisers, Sir Wm. Preece and Major Cardew, that they did not know of any other company than Edmundson's likely to offer to undertake the lighting of the parish, the U.D.C. has resolved to invite the Edmundson Corporation to submit tenders and a draft agreement.

Finchley.—The Finchley Improvement Bill, which has been promoted by the D.C., has been voted upon by the parish, with the result that the necessary sanction has been refused by a majority of 361 out of 3,543. This Bill contained provisions empowering the Council to borrow about £85,000 for electricity purposes. The D.C. will proceed with a scheme under its prov. order, but it is proposed that the estimate shall not exceed £45,000.

Frome.—The Committee appointed to deal with the subject of electric lighting has recommended the Council to make application for sanction to borrow the sum of £16,400, and to appoint Mr. F. H. Medhurst as consulting engineer, at a commission of 5 per cent. on the original scheme and 3 per cent. on extensions.

Gillingham.—The U.D.C. has considered the proposed extension of the E.L. undertaking relative to the supply of electric energy to the new Naval Barracks erected by the Admiralty, near Chatham Dockyard, and has decided to quote terms for periods of 10 or 15 years. The new Naval Barracks is said to be the largest of its kind in the country.

Godalming.—The T.C. has arranged with the Urban Electric Supply Company (who took over the Council's order) to light 86 street lamps with 25-C.P. lamps as soon as possible, and the remaining 150 lamps by January, 1903. The details of the contract are not entirely settled, but the company's alternative offers for 256 lamps, as compared with the cost of gas lighting, are as follows:—

	Half night.	Whole night.
Electricity, 25 C.P.	£649	£885
,, 32 ,, ...	767	1,003
,, 50 ,, ...	885	1,262
Gas.. 25 ,, ...	883	1,230

The above charges include repairs, cleaning, and maintenance. The term "half night" means from half an hour after sunset to midnight.

Hendon.—Since the inquiry, representations have been made to the L.G.B. that a satisfactory scheme can be carried out at less cost than that proposed by the D.C. The Board sent these representations to the D.C., whose observations in reply were received and a decision on the application will be very shortly arrived at. At a meeting of the D.C. it was stated that the representations had been made by the Electrical Power Distribution Company, and that Mr. Hammond, the Council's engineer, had been instructed to reply thereon. A sub-committee of the D.C. has been formed to consider what steps can be taken to obtain from the B. of T. a further postponement of time for the commencement of the works.

Hereford.—The accounts of the electricity supply department for the past year show that the energy supplied was greater by nearly 50 per cent. than in 1900, and after paying working cost and interest there remained £676 towards repayment of capital.

Hornsey.—The U.D.C. on Monday evening discussed a report from the Lighting Committee, recommending the erection of 60 arc lamps to replace 87 gas lamps. The arc lamps are estimated to cost £1,292 per annum and the gas lamps £265 per annum, so that the increase will be £1,027 per annum. The report was referred back.

Irvine.—The Burgh Commissioners are considering a scheme for the electric lighting of the burgh.

Kimberley.—According to *The British and South African Export Gazette*, the De Beers new central power station will have a capacity at first of 2,000 KW. Power will be generated at 5,000 volts, and transmitted on the three-phase alternating system, with a frequency of 30 cycles per second. The eight boilers to be installed will be of the Babcock & Wilcox type, with superheaters and mechanical stokers of the chain-grate type. Mechanical draught fans and economisers will also be installed. Two sets of Westinghouse-Parsons turbines and Westinghouse generators will be erected, each having a capacity of 1,000 KW., and room will be allowed for installing another unit at a future date. The order for the switchboard has been placed with the General Electric Company, of New York. The cables, which are being supplied by the British Insulated Wire Company, Limited, are paper-insulated, lead-covered, and armoured, and laid underground. The plant is expected to be in operation about the latter part of the year.

The electricity accounts for 1901, recently presented by the borough electrical engineer, Mr. C. Granville Vines, show a total output of nearly 139,000 units, sold at 1s. per unit. The total capital expenditure amounted to £31,363; the gross revenue amounted to £7,024, gross expenditure £5,493, gross profit £1,531. The cost of production per unit was made up roughly as follows:—Coal, &c., 5·87d.; oil, waste, &c., ·38d.; water, ·49d.; salaries and wages, 1·70d.; repairs and maintenance, ·11d.; total works cost, 8·55d. Management, ·75d.; establishment charges, &c., ·19d.; total costs, 9·49d. After paying £1,186 interest, and £1,612 for depreciation and sinking fund, there was a net deficit of £1,267. The number of lamps installed was 15,000 of 8-C.P.; maximum load, 206 KW.; capacity of plant, 300 KW. The bulk of the supply is for private lighting, by meter. It should be observed that these data are for the first complete year of running; coal costs 50s. per ton, and is of only half the calorific value of Welsh coal. The choice of a flat rate of 1s. per unit, which was fixed by the Council before Mr. Vines's appointment, was perhaps not the best under the circumstances, as Saturday night shopping is a great institution in Kimberley, and while the shopkeepers run up a heavy demand for lighting on these occasions, they take practically nothing at other times. More capital is badly needed for extending the plant and mains, but as the Cape Parliament is not sitting, thanks to the war, it is impossible to obtain sanction to further loans at present. An 80-KW. Belliss-Parker set is on order, but will be quite inadequate to meet the demand.

Long Eaton.—An influential meeting of ratepayers was held recently to protest against the action of the U.D.C. in disregarding the suggestion of the L.G.B. in regard to the erection of a generating station. The meeting was in favour of taking power in bulk from the Notts and Derby Power Company.

London.—In the House of Commons last week Mr. G. Balfour, President of the Board of Trade, brought in a Bill to provide for the adjustment, in accordance with changes of boundary effected under the London Government Act, 1899, of the areas within which local authorities and companies are authorised to supply electricity. The Bill was read a first time without discussion.

GREENWICH.—The B.C. is going to engage an electrical engineer, at a fee not exceeding £50, to report upon the electric lighting of the borough.

WOOLWICH.—In view of the anticipated increase of business, consequent on the M.B.C. taking over and extending the local company's electric lighting plant, the Council has decided not to close up temporarily the ends of the new engine and boiler house at Plumstead, but forthwith to extend the walls at a cost of £1,350, thus ultimately saving £467 on the total estimated cost of the whole building.

The Council has approved of the application of the Blackheath and Greenwich District Electric Light Company for a Board of Trade license for Eltham, subject to conditions.

BERMONDSEY.—At a meeting of the London County Council on Tuesday, the Highways Committee reported having received a deputation from the Bermondsey Borough Council on the subject of the proposal of the former to ask the Board of Trade to fix 6d. as the maximum charge in the provisional order being applied for this session. The deputation pointed out that 8d. was inserted in the 1899 order granted to the late Bermondsey Vestry, and suggested that the same maximum should be included in the present order, which would apply to the enlarged area under the Borough Council. The committee, however, saw no reason for altering their recommendation to ask for the introduction of the 6d. maximum which the Board of Trade embodied in the London orders issued last year.

Loughborough.—The T.C. has accepted the recommendation of the General Purposes Committee that the prov. order should be transferred to the Loughborough Light Railway Syndicate, which has obtained an order for the establishment of light railways in the district. The syndicate will carry out both the Council's light railways and electric lighting scheme, and the terms of purchase (which have already been published in the ELECTRICAL REVIEW) are particularly favourable to the town.

Lutterworth.—The U.D.C. has decided to offer no real opposition to the Warwickshire and Leicestershire Electric Power Bill.

Middlesbrough.—A L.G.B. inquiry was held last week by Mr. R. H. Bicknell, M.I.C.E., into the application of the T.C. for sanction to borrow £7,570 for the purpose of electric lighting, and £16,000 for other purposes. Mr. R. Hammond, jun., consulting engineer, said that the demand at the end of December was for 21,500 lamps. With their new plant they proposed to increase this to 35,700 lamps. This would carry them over next winter, but if the light continued to grow in popularity another extension would prove necessary.

Monmouth.—The T.C. being in financial trouble, owing to their electric lighting scheme having cost them £15,000, or £10,000 more than the estimate, and wanting that sum to complete the work, Lord Llangattock has made himself responsible for the sum required for six years.

Pembroke.—Last week Mr. P. C. Cowan, L.G.B. inspector, held an inquiry into the application of the U.D.C. for leave to borrow £20,000 for electric lighting purposes, and £8,000 for the widening of Ball's Bridge. Mr. Hammond, engineer to the Council, and Mr. Sydney, resident engineer, gave evidence with regard to the first-named loan.

Pontefract.—The Guardians have received a comparative statement showing the relative cost of gas and electric light on the union premises, from which it appears that there has been a saving, by the introduction of the electric light, of £15 on the half-year.

Rhyl.—At the Flintshire Assizes some days ago the case of Holloway *v.* the Western Electric Company came on for hearing. Miss Holloway, who was a confectioner at Rhyl, claimed £100 damages from the Western Electric Light Company, Woolwich, as damages for injuries sustained through falling over an electric light pole which was lying in the gutter in such a way that it was above the surface of the footpath. It was alleged that there was no light or protection of any kind. For the defence it was argued that the defendants exercised reasonable care. Witnesses who were employed on the work were called to show that a light was placed at each end of the pole, and that the pole had been made firm by heaps of sand. The jury returned a verdict for the plaintiff, damages £50.

Sheffield.—On Thursday last week the supply of electricity on the two-phase system at 50 cycles per second was commenced, the single-phase 100-cycle plant being then shut down.

Sunderland.—On Friday last Col. A. G. Durnford, R.E., held an inquiry into the application by the Corporation for powers to borrow £30,000 for the purposes of electric lighting. The money was required for the following purposes:—Building main shed, cooling tank, &c., at the Hylton Road station, £1,300; machinery for Dunning Street station, additions to switchboard, and cooling tower, £700; Hylton Road station extensions and coal gantry, £2,350; deep well and pump, £1,000; extension of mains, £12,220, and provision for future extensions, £12,430. Mr. J. F. C. Snell, the borough electrical engineer, stated that the extensions were necessary to meet the increased demand for electricity for lighting purposes. Last year they disposed of 96,000 units, and they expected that 200,000 would be required this year.

Sutton.—The electric light works are now completed, and the supply of electricity was begun this week.

Sutton Coldfield.—The D.C. has decided to borrow £29,501 for electric lighting purposes.

Walton.—A scheme is on foot at Walton-on-Naze to utilise the backwater, so as to produce by means of the old tidal mill sufficient electrical power to light the town and to drive factories.

Waterloo.—The L.G.B. has sanctioned the borrowing of £2,000, to be expended on electric lighting in the district.

Worthing.—The E.L. Committee, on the advice of Messrs. Burstall & Monkhouse, recently recommended that a loan of £11,000 be obtained to provide an additional 250-KW. generating set, boiler and condenser, with corresponding extensions to the buildings. The recommendation was adopted.

Whitby.—The electric street lighting was begun last week.

Sunderland.—A L.G.B. inquiry was held last week into an application by the Corporation for leave to borrow £30,000 for purpose of electric lighting.

Wolverhampton.—The mains are to be extended at an estimated cost of £955; and two balancers are to be purchased from Messrs. Crompton & Co. at the price of £200.

ELECTRIC TRACTION NOTES.

Aberdeen.—Tenders are to be invited for 12 new electric cars and the electrical equipment of nine horse cars, the cost being estimated at £10,350.

Belfast.—The Corporation has given notice that it will oppose the Bill about to be promoted in Parliament for the electric equipment of the Cavehill and Whitewell Tramway. Our local correspondent, who sends us this information, adds:—"This is quite consistent with the dog-in-the-manger policy pursued by the Corporation. It has not the nerve to face the local tramway difficulty, and will do its best to prevent the suburb of Whitewell from sharing in the benefits of electric traction."

Deptford.—The M.B.C. has been notified that the L.C.C. has withdrawn the clause in its Tramway Bill compelling the M.B.C. to contribute towards street widening, and the Council has accordingly consented to the Bill, but without prejudice to any further possible opposition.

Derby.—The T.C. has decided to oppose the application of a company for the Derby, Nottingham and District Light Railway Order.

Dewsbury.—It is announced that a new company will be formed by the British Electric Traction Company to control the tramways to be constructed in the heavy woollen district of Yorkshire, of which Dewsbury forms the centre. The capital is to be £300,000, and Sir T. Pilkington, of Cheviot Hall, Wakefield, will be the chairman. Negotiations are still proceeding between the company and the Batley Corporation, who have obtained powers to construct electric trams within their own area, and it seems probable that an amicable arrangement will be arrived at. Should the Corporation agree with the company, it is said that the latter will promote a Bill next November to enable them to lay double lines in Bradford Road, along which the present steam trams run from Dewsbury to Gomersal. It is proposed that the rails should be laid by the Corporation, and then leased to the company, who will pay a rental sufficient to cover the interest on the loans and provide a sinking fund for the liquidation of the debt. The lease would be for 28 years, and current would be taken from the Corporation. The agreement is similar to the one entered into between the company and the Dewsbury Corporation. It is further understood that the company will pay a portion of the expenses incurred by the Batley Corporation in obtaining Parliamentary powers. Messrs. Dick, Kerr & Co., have secured the contract for laying the line, erecting the wire, standards, &c., from Dewsbury to Ravensthorpe, Thornhill, and the Spen Valley. The company has agreed to take energy from the Dewsbury Corporation and the Heckmondwike and Cleckheaton Urban District Councils. Negotiations are now proceeding between the Dewsbury Corporation and the promoters of the Wakefield and District Light Railways, who propose to carry out a scheme from Dewsbury to Wakefield *viâ* Ossett and Alverthorpe.

Glasgow.—The litigation regarding speed of cars which was some time ago dismissed by the Glasgow Sheriff Court, on the point that the pursuer, Mr. Thomas Simpson, engineer, The Hollow, Albert Road, Pollokshields, Glasgow, had no title or interest to sue the Corporation for running the cars in excess of the Board of Trade limit, was before the Court of Session, Edinburgh, on 29th ult. The Lords of Session found that pursuer had title, and had proved interest to prosecute, and sent back the case to the Sheriff for further hearing. Under the regulations governing the Glasgow Corporation Tramways Act, 1900, eight miles an hour is the limit. From the proof it appeared that speeds varying between that and 21 were taken on cars passing the pursuer's house, and that danger to pursuer and his family constituted interest to prosecute. In this their Lordships concurred, and they stated that pursuer was entitled to half the penalty liable as informer, and that such penalty can be recovered under the Railway Clauses Consolidation Act (Scotland), 1845. Generally speaking, this is the only complaint with regard to speed, as the public now recognise the advantage of an accelerated service, for which ample proof is obtained by the increased drawings for the present year so far elapsed since June 1st, exceeding the previous year's drawings by an increase of £95,450.

Liverpool.—At a meeting of the Tramways Committee last week a revised schedule of electric car stages for the City of Liverpool was adopted. In almost every instance the revision will mean an extension of the limit of the 1d. fare, some of the extensions being considerable. Several new stages have been formed. The revised schedule will come into operation on May 1st next.

London Underground Railways.—The following important discussion on the London underground railways and future action in regard to new projects, took place in the House of Lords on Monday. We are indebted to the *Times* for the report:—Lord Glenesk, with the object of securing that, in the development of the "tube" railway system under London, there should be some recognised system and principle, moved:—

That it is desirable that the Joint Select Committee on London Underground Railways appointed last Session be appointed to consider and report whether any of the lines of route for underground railways in and near London, proposed by the Bills which have been introduced during the last and present Sessions, afford adequate facilities for present and probable future traffic; whether any extensions or alterations of route are required for the purpose of providing cheap and rapid travelling communication throughout London and the outskirts, and whether the making of such extensions or alterations should be a condition of the grant of powers to make any proposed railways; what is the best method of constructing, working, and ventilating such railways, having regard to the safety, health, and convenience of persons travelling by them.

The Earl of Morley admitted the importance of the subject, which was intricate and worthy of consideration. The projects for tube railways were increasing every year. There were at present eight lines authorised in London, two of which were in actual operation, two in course of construction, and four sanctioned but not yet commenced. Last year 11 Bills were introduced, of which seven were new schemes and four were extensions of authorised lines. These Bills were referred to a Joint Committee appointed to consider the questions of convenience of route, protection to owners of house property, conditions as to construction and maintenance, and which of the 11 Bills should be allowed to proceed. The Committee recommended that seven of the Bills before them should be allowed to proceed, and as regards four of the Bills the Committee expressed a view in favour of a continuous extension of the lines between Hammersmith and the City. Nine of these Bills had survived the period of suspended animation and were now again before the House for consideration. In addition to these measures 15 were now before the House dealing with tube railways; but nine dealt with extensions of works on authorised railways, two were for extensions of time, and only four were new schemes. The grounds on which the noble lord would refer these schemes to the Joint Committee were almost completely covered by the Committee last year, and the only result of referring these Bills would be to delay them for another year. The delay would be not only serious for the promoters but it would be inexpedient in the public interest, for the traffic in the London streets was becoming more and more congested and the construction of lines to the suburbs was most important in relation to the housing of the poor. There was nothing in the new schemes of this year that had not received the consideration of the Joint Committee last year. The only difference was that there was a new line projected from the City to the Crystal Palace which would probably not be much objected to, and that the communication between Putney, Hammersmith, and the City was competed for by a larger number of companies than last year. The consideration of the relative merits of the different competitors might be safely left to an ordinary committee. He was endeavouring, in conjunction with the President of the Board of Trade, to devise some means by which all these Bills might be grouped and dealt with by two or more committees who would be guided to a large extent as to general principles by the very admirable report of the committee of last year. To three of that committee's recommendations he wished to call attention. The first was that the County Council and City Corporation should be granted a *locus standi* in all cases of extension of time. This was a valuable suggestion, and he felt certain that the committees would give a very liberal interpretation to any precedents when considering the *locus standi* of these bodies. The second point he wished to call attention to was that a clause in the report recommended—and he had great sympathy with the recommendation—that there should be some central body to control these schemes. With regard to that, he thought Parliament would be very jealous of giving up any powers it now possessed over them. His third point was that the committee suggested that power should be given to corporations and the County Council, as in the case of light railways, to construct or assist in constructing these tube railways. Without arguing whether or not that was desirable, he thought it was a very doubtful expedient. At any rate, it was an entirely new departure, and it had never been discussed in Parliament. In consequence of that recommendation clauses had been introduced into many private Bills this year giving the County Council that power. He thought such a power should not be given unless Parliament deliberately and after full discussion came to the conclusion that it ought to be. He therefore proposed to strike out of every Bill in which it occurred that particular clause before the Bill went to a committee.

Viscount Knutsford, as a member of the Joint Committee of last year, desired to remind the noble earl that the clause in the report embodying the recommendation last referred to by him was only

carried by a majority of one. In the interest both of the promoters of schemes and of the working men of London he hoped the resolutions before the House would not be agreed to.

Earl Spencer said he shared the views of the Chairman of Committees. Nearly all the points referred to in the resolutions before the House were fully discussed by the committee of last year. He agreed that it was of enormous importance that these tube railways should be properly regulated, and if possible by one public body. He hoped the House would support the noble earl in the course he proposed to take with regard to private Bills, in which it was proposed to give the County Council power to contribute to such schemes. He thought the principle involved in that proposal should be fully discussed in Parliament before it was introduced.

The motion was withdrawn.

Luton and Dunstable.—A Light Railways inquiry was held at Luton on Wednesday last week regarding the application for an order to run an electric trolley railway for Luton, Dunstable and District. Mr. Basset Hopkins gave evidence, showing that the line is 10 miles long on a 4-ft. 8½-in. gauge. Arrangements have been made to take supply from the Luton Corporation electricity works. The scheme is to cost £160,000.

Newport (Mon.).—A sub-committee of the County Council recently went on a visit of inspection to Hadley and Manchester. They have reported to the Council, having visited the car-building works of Messrs. Milnes, at Hadley, the works of the British Westinghouse Company, the British Electric Car Company's works, the cable factory of Messrs. W. T. Glover & Co., of Manchester, and the electricity works of the Manchester Corporation. After detailing what they saw of car building at Messrs. Milnes's works, the sub-committee "are of opinion that the design of car should be that now being made for the South Lancashire Tramway Company, subject to slight alterations in roof construction, and that the option given by the tender of the British Westinghouse Company be exercised, and that Messrs. Geo. F. Milnes & Co., of Hadley, be selected as the makers of the car bodies."

Paris.—In the course of a strong criticism of the electric tramway undertakings of Paris, a French writer says that, with a much too cheap level of fares, and a bad arrangement of routes, there is nothing but bankruptcy in store for the greater number of the existing companies.

Penge.—The U.D.C. has resolved to oppose the B.E.T. Company's scheme, if terms satisfactory to the Council cannot be arranged, and while negotiations with the company are pending, to endeavour to take joint action with Beckenham, and other local authorities, with a view to obtaining a Bill authorising a joint tramway.

St. Helens.—If every Corporation will but act as ungenerously towards companies which seek to develop their localities as the Corporation of St. Helens have done towards the St. Helens and District Tramways Company, over the company's request to be permitted to carry goods on their tramways, the development of electrical traction will be effectually retarded, and corporations, like other people, will be the losers. The application of the St. Helens and District Tramways Company has been before the St. Helens Corporation for about a couple of months, and has been considered at several meetings. The Tramways Committee of the Council proposed a reasonable scheme of working, but the Council disposed, and the matter was thrown back. A Joint Committee of the Parliamentary Committee and the Tramways Committee then tried to settle the question, but made little progress with it. On Saturday the subject was again discussed by the Joint Committee, Messrs. Atherton and Martin, two directors of the Tramways Company, being present. After a long discussion, Colonel R. Pilkington moved, "That the Tramways Company be permitted to carry goods, but on terms which would ultimately mean a payment of 20 per cent. on the gross receipts, plus a small charge per wagon." The town clerk drew the attention of the Joint Committee to the fact that at a previous meeting Colonel Pilkington had proposed that the charge should be 10 per cent., and that this had been agreed to and communicated to the company. The proposal made by Colonel Pilkington was, however, carried. Then the town clerk informed the Joint Committee that in view of the previous decision and action, it would be unprofessional of him to communicate the fresh decision of the Committee to the Tramways Company, and he declined to do so. At this the matter remained, the meeting closing.

Sheffield.—The Tramways Committee have informed the City Council that they are willing to transfer £5,000 out of the profits on the tramway undertaking to the Finance Committee, to be applied in payment of interest and in relief of the general district rates. During the five weeks ending February 2nd 4,741,301 passengers were carried on the Corporation tramways, £18,126 4s. 5d. being received in fares.

The estimated capital expenditure to be incurred by the Tramways Committee during the next financial year amounts to £138,061 9s. 10d. The items are:—Tramway tracks, &c., £55,000; buildings, &c., £20,000; car shed extensions, extra car fittings and workshop tools, £16,000; extensions of power station, £10,308; equipment of new routes, special cable tunnel, extra cable ducts and cables, £36,753 9s. 10d.

Southall and Norwood.—The U.D.C. has discussed the extension proposals of the L.U.T., and will consent to the company's scheme if the roadways are uniformly widened to 50 ft., wood paved, lighted, and scavenged, and an annual rental of £500 is paid to the Council.

Southampton.—Mr. H. F. Street has reported to the Tramway Committee recommending certain alterations in the overhead equipment, and in other directions, and the Committee has asked him to report upon the whole tramway equipment.

Spain.—Plans have been completed for the construction of a projected light electric railway on the overhead trolley system between Santiago and Coruna, a distance of 65 kilometres. It is proposed to utilise the water-power of the river Tambre in the generation of the necessary electrical energy.

Tyneside.—A special meeting of the Tyneside Tramways and Tramroads Company was held on the 3rd inst. at Newcastle-on-Tyne, at which the Bill now being promoted by the company in Parliament "for the construction of tramways and tramroads, and for other purposes," was approved. Mr. McClellan reported that the contract for the permanent way had been let, as also for the motor sheds and cars. Work had been started at Wallsend, and the whole of the various tramways were due for completion in June. They had got about half a mile of tramway line laid at present, but progress had not been good last week on account of the frost. The contractors were pushing the work on, and he thought they would finish it pretty well up to time if they were given good weather. A shareholder stated that the revenue of the Tynemouth and North Shields line had been £11,000, and the expenses £5,000, or 48 per cent. The opinion was expressed that this was most satisfactory.

Vibration on Underground Railways.—The *Times* of 8th inst. says in its "Political Notes":—"We understand that the committee appointed by the Board of Trade in January last year to inquire into the vibration produced by the working of the traffic on the Central London Railway have presented their report to Mr. Gerald Balfour. As a first step, the committee satisfied themselves by personal observation that vibration sufficient to cause serious annoyance is actually felt in many of the houses situated along the course of the railway. Exhaustive experiments, entrusted to engineering experts, were then carried out with a view to locating the origin of the trouble and to discovering a remedy. After carefully weighing all the evidence placed before them, the committee decided to recommend the adoption of a type of locomotive or motor in which the load not carried on springs is reduced as far as possible. This, the report explains, may be arrived at by using gearing as in the geared locomotives or motor carriages, or by using a gearless locomotive in which an elastic communication is employed between the driving axle and the motor; but the committee had no opportunity of experimenting with a locomotive of this type. In the trials carried out the motor cars were found to have an advantage in freedom from vibration over the geared locomotive. So far as the Central London Railway is concerned, the committee are confident that, by adopting motor cars in place of the ordinary locomotives, the vibration produced by the running of the trains can be reduced so as to cause no serious annoyance, although it is possible that the sound of the trains may still be detected, especially in the night. The report proceeds to state that the committee are able to speak positively as to the motor cars, but they have little doubt that any method of driving in which the unspring-borne load on each axle is reduced to a similarly small quantity might also be used with impunity. They are disposed to prefer a stiffer rail than that in use on the Central London Railway, and they think that in new undertakings sufficient room should be allowed for the introduction of a deeper rail; but they are of opinion that, without altering the permanent way of the Central London Railway, the change of motors which they recommend will effect a practically complete cure of the disturbance complained of. It may be added that, in order to ascertain whether a specially severe disturbance could be connected with particular trains on the Central London Railway, the committee instituted elaborate observations in which 10 or 12 observers were stationed in various houses, and recorded, during the whole of one day, the times of passage of the trains and the estimated intensity of the vibrations. A comparison of these records with records made at the stations by other observers of the precise times of starting and arrival of the various trains showed (*a*) that it was a matter of chance whether a given train caused a slight or a severe vibration; (*b*) that trains causing a severe vibration in one house were as likely as not to cause only a slight vibration in the others; and (*c*) that different rooms in the same house were not similarly affected by the same train. The report is signed by Lord Rayleigh (chairman), Sir J. Wolfe-Barry, and Prof. Ewing."

Wallasey.—Three routes of the new Wallasey district electric tramways are rapidly approaching completion, to be formally opened at Easter. Each route will extend from Seacombe Ferry to New Brighton Ferry, but through different parts of the district. For the inaugural service 20 cars have been ordered from Messrs. Dick, Kerr & Co., and are of the same pattern as the cars made for the Liverpool Corporation, of the double-deck type. They will accommodate 22 passengers inside and 34 outside. The overhead work has been carried out by Messrs. R. W. Blackwell and Co., and includes about 20 miles of trolley wire, for which 400 ornamental standards of special design have been manufactured. Rails for about 10 miles of route have been supplied by the Barrow Hæmatite Steel Company. The generating station is in Sea View Road, and will contain two 300-KW. compound-wound generators coupled direct to high speed engines to supply a continuous current. The work has been carried out under the supervision of Mr. W. H. Travers, engineer and surveyor to the Wallasey District Council.

Wolverhampton.—The report by Colonel Yorke in reference to the Lorain experimental surface contact section of tramways here reads as follows:—"The principal feature of this tramway lies in the method adopted for supplying the electrical current to the cars. Instead of the usual overhead trolley wires there are placed in the centre of each track contact plates of hard chilled iron about 12½ in. long by 6¾ in. wide at a distance of 10 ft. apart from centre to centre. The plates are slightly convex, the centre of each plate being about ½ in. higher than the edge; and they are so laid that at the highest point they are ¾ in. above the rails. Each plate is supported on a hollow base or box, 16 in. long, 10¼ in. wide, and 7½ in. deep, made of an extremely hard material called 're-constructed granite.' The boxes rest upon the concrete foundation which underlies the track. The contact boxes are very conspicuous in a street paved with wood or asphalte, forming a series of excrescences above the surface, which are, to say the least of them, undesirable. In a street paved with granite setts, the surface of which is irregular, the plates are not so noticeable. But it has to be borne in mind that the surface of a street is apt to settle slightly as well as to wear away. The plates, however, cannot settle or wear to any appreciable extent, and as the street surface sinks the plates will project more and more above it. An unsightly condition will thus arise, and one which, apart altogether from electrical failures, may be a source of inconvenience, and possibly of danger, to vehicular traffic. The Corporation of Wolverhampton deserve credit for their enterprise in testing this novel system, and it is to be hoped that my fears will not be verified. For the present I can recommend the Board of Trade to certify the track between the places mentioned at the beginning of this report as fit for traffic, and, subject to Mr. Trotter's report and to the condition in Clause 41, Sub-section 4b of the Wolverhampton Corporation Act of 1899, to authorise the working of the line by electrical traction on the Lorain Surface Contact System for a period of 12 months. The speed over the line should not exceed eight miles an hour, except through facing points, where it should not exceed four miles an hour. The cars—some of which are single-deck and some double-deck—are fitted with hand brakes and electric brakes, the double-deck cars having in addition slipper brakes. They also have the Providence car fender or lifeguard, which I think is open to serious objection owing to the distance to which it projects in front of the car. It occupies a considerable amount of street space, and is only brought into operation at the discretion of the driver. Moreover, when a car is going round a curve, the fender projects outside the track to a dangerous extent. Although this type of fender is, I was informed, in frequent use in America, I do not regard it as suitable for the conditions existing in English towns. The Corporation of Wolverhampton should be requested to adopt some other pattern of fender before any more tramways are submitted by them for inspection."

Mr. Trotter states:—"The tramways are worked on a surface-contact system; blocks are placed at intervals in the street containing a contact which is worked by powerful magnets carried on the car. When the car passes the pieces of iron which produce the contact, they are allowed to drop. Should one of these fail to drop a horse treading on the block would probably be killed, but a foot passenger treading on it would receive a shock, which would not be dangerous to life, but which might make him stumble and be run over. I have examined the details of the contacts, and I think that an accident to a horse is unlikely, and the risk of an accident to a foot passenger very remote; but as there is no experience in the use of this system, subject to the report of Colonel Yorke, I recommend that sanction be given for the working of this system for 12 months."

The Town Council, at their meeting on Monday, decided to call in an electrical expert to advise the electrical engineer and the Tramways Committee respecting the running of the tramcars on the Lorain experimental line. This has been done really in consequence of stoppages which occurred on Saturday, Sunday, and Monday, caused by the snow.

TELEGRAPH AND TELEPHONE NOTES.

Dublin Telephones.—The Corporation Improvements Committee recently received a communication from the Consolidated Telephone Construction and Manufacturing Company, Limited, proffering their services in case the Corporation should decide to establish a municipal telephone system.

Sheffield Telephones.—Mr. A. R. Bennett has been instructed to report fully as to the cost of installing and maintaining a municipal telephone exchange in Sheffield.

Southport Telephones.—The chairman and vice-chairman of the Southport Corporation Telephone Committee have reported on the negotiations entered into with the District Councils of Ormskirk, West Lancs., Lathom, Burscough, and Skelmersdale, with regard to the proposal of the Corporation to establish a telephonic exchange, and it was resolved that the application to the Postmaster-General for a license to establish a telephonic exchange be for the area comprising the townships of Southport, Birkdale, Aniadale, Bickerstaffe, Formby, Altcar, Downholland, Scarisbrick, Halsall, North Meols, Anghton, Ormskirk, Skelmersdale, Lathom, Burscough, Bispham, Hesket Lydirk, Maghull, Melling, Rufford, Simonswood, and Tarleton.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Mole St. Nicholas-Port au Prince	Dec. 28, 1901 ..	Feb. 7.
Havre-Waterville	Jan. 27, 1902 ..	Feb. 5.
Alexandria-Larnaca	Jan. 19, 1902 ..	..
Trinidad-Demerara	Jan. 30, 1902 ..	Feb. 11.
Landlines:—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..

Telegraph Rates to India.—Sir Edward Sassoon Bart., M.P., speaking at Folkestone last week, stated that it ha been decided to reduce the telegraphic rates to India from 4 per word to 2s. 6d., with a further prospective reduction (subjec to the first reduction paying) to 2s.

The Telegraph Wire Export Trade.—While not quit so large as on the first month of 1901, the new year has started o well as regards the exports from this country of telegraph wire an apparatus connected therewith. During January the shipment attained a value of £586,285, as compared with only £37,572 i December last, and £596,122 in January, 1901.

Tunbridge Wells Telephones.—A L.G.B. inquiry wa held on Tuesday with reference to an application by the Corporation to borrow a further sum of £15,000 for the purpose of extending th municipal telephone system. Mr. W. C. Cripps, the town clerk stated that six months ago the Corporation applied for a loan o £10,000 for commencing the system, and it was calculated that th would enable them to provide communication for 319 subscribers So successfully had the Corporation managed the undertaking th there were at the present moment 533 revenue-bearing lines i existence, and 283 persons were waiting to be connected, making total of 816 subscribers. The maximum rate charged by the Co poration was £5 17s. 6d., but the average amount received fro subscribers was £4 11s. 5d., there being also two toll rates i existence. The general desire, however, was to have unlimite service, and the average therefore was constantly rising. In t face of the rapid increase in the number of subscribers it had be found necessary to considerably enlarge the scheme, and the Tow Council now asked for a further loan of £15,000. The experienc of the first six months, which were generally the most crucial i undertakings of that sort, had been extremely satisfactory so far a finances were concerned, and calculating upon the results alread achieved there would be a profit at the end of the year of £1,0 That had been achieved in spite of very energetic opposition on th part of the National Telephone Company, who, since the Corporatio started their system, had reduced their charges from £10 to £ The inquiry was adjourned until March 6th.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—February 15th. Overhead equipment, pol and bonding; also cables for three tramway routes. See "Offici Notices" January 31st.

Aberdeen.—March 6th. Twelve double-deck single truck cars and equipments for the Corporation. See "Offici Notices" to-day.

Aberdeen.—March 6th. Overhead equipment, bonding and cables for the Corporation tramways. See "Official Notices to-day.

Battersea.—February 18th. Coal, carbons, meters an stores, for the electricity department. See "Official Notices February 7th.

Belgium.—February 15th. Proposals are being invite by the municipal authorities of Lourain for the lighting of th public streets by electricity or gas.

Belgium.—March 1st. The municipal authorities Ghent are inviting tenders until the March 1st, 1902, for t concession for an electric lighting installation. See our "Offici Notices" January 3rd.

Belgium.—March 1st. Tenders are being invited unt March 1st by the municipal authorities of Braine l'Alleud for t concession for the electric lighting of the town. Tenders are to sent to Le Secretariat Communal de Braine-l'Alleud, whence pa ticulars may be obtained.

Birkenhead.—February 24th. Lancashire boiler an stokers for the Corporation electricity works. See "Offici Notices" February 7th.

Bournemouth.—February 21st. Motor-generator f Corporation tramways. See "Official Notices" February 7th.

Burgess Hill.—March 12th. Offers for the constructio of electricity works are invited by the U.D.C. For conditions, & see our "Official Notices" to-day.

Christiania.—February 19th. H.M. Consul-General at Christiania reports that tenders are invited for 3,000 metres 1·5 millim. india-rubber insulated copper wire; 4,000 metres seven-strand india-rubber insulated copper cable; 100 kilog. tinned plain copper wire; 150 kilog. three-strand plain copper wire.—Telegraph Inspector's Office, No. 8, Stenersgade, Christiania.

Croydon.—February 17th. 10 double-deck double-truck cars with motors, &c., for Corporation. See "Official Notices" January 24th.

East Ham.—February 22nd. One 500-KW. c.c. generator with 800-I.H.P. engine; water-tube boilers, condensers, &c., for the U.D.C. See "Official Notices" February 7th.

Edinburgh.—March 3rd. Electric lighting installation for the third portion of the Colinton Mains Fever Hospital (600 points) for the Council. See "Official Notices" February 7th.

Fulham.—February 26th. Two 50-KW. steam dynamos and boosters, four dryback marine boilers, battery, and wiring for 2,000 lights, for the Guardians. See "Official Notices" January 31st.

France.—February 28th. The French Post and Telegraph authorities in Paris are inviting tenders until the 28th inst. for the supply of 10 tons of galvanised iron wire 1 mm. in diameter, 80 tons ditto. 3 mm. diameter, 80 tons ditto. 4 mm. diameter, and 340 tons ditto. 5 mm. diameter. Tenders are to be sent to Le Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

Glasgow.—February 21st. Switchboard extensions for the Corporation. See "Official Notices" January 31st.

Islington.—February 26th. Tubular well and pumping gear, at the electricity works. See "Official Notices" February 7th.

King's Lynn.—February 21st. A Lancashire boiler and piping for the electricity works. See "Official Notices" February 7th.

Leeds.—Concentric (high tension), two-phase (low tension), and L.T. triple-concentric paper cables for the electric lighting department. See "Official Notices" January 31st.

London.—March 4th. The L.C.C. is wanting tenders for 100 or 50 double-deck double-bogie tramcars for conduit lines in South London. Drawings, &c., at the County Hall, Spring Gardens, S.W. (£3).

Maidenhead.—February 25th. Easy wiring proposals are invited by the E.L. Committee from firms willing to undertake the work. See "Official Notices" to-day.

Manchester.—February 19th. Electric travelling crane for generating station, and hand travelling cranes for sub-stations. See "Official Notices" February 7th.

Oban.—March 7th. Piping, balancing transformers, and motor-generators, battery, switchboard, arc lamps, cable work, and crane for the Corporation electric lighting. See "Official Notices" to-day.

Pemberton.—February 19th. Balancing and boosting set for the U.D.C. See "Official Notices" February 7th.

Pontypridd.—March 7th. Overhead equipment and bonding for the U.D.C. tramways. See "Official Notices" to-day.

Rochdale.—February 25th. Traction switchboard and accessories, for the Corporation. See "Official Notices" February 7th.

Rockhampton (Australia).—March 31st. The Council of the Municipality of Rockhampton is prepared to consider applications from companies desirous of undertaking the construction and working of a system of electric tramways under the Queensland Tramways Act of 1882, and the Amendment Act of 1890. See ELECTRICAL REVIEW, January 10th.

Salisbury.—March 4th. The directors of the L. & S.-W. Railway wants tenders for the electric lighting of Salisbury station. See "Official Notices" to-day.

Stalybridge.—March 3rd. Rails, points, crossings, tie-bars, bolts, trolley wire, &c., for the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board. See "Official Notices" to-day.

Sunderland.—February 28th. Lathe, drilling, and shaping machines, and other workshop tools for the Corporation electric lighting department. See "Official Notices" to-day.

CLOSED.

Bradford.—The T.C. has accepted the offer of the Brush Electrical Engineering Company, Limited, for the supply of 100 tramcar trucks for the sum of £5,000, and the offer of Messrs. Back and Manson to supply 12 miles of trolley wire for £938; also that of the British Insulated Wire Company, Limited, to supply six miles of ·25 cable at £278 per mile, and three miles of ·15 cable at £202 per mile.

Bournemouth.—The T.C., at their meeting on January 21st, reported that the following tramway tenders for contract No. 13 for traction feeders, cables, &c., had been referred to their engineer to be reported upon:—

	£	s.	d.		£	s.	d.
British Insulated Wire Company	22,398	2	1				
Do. with stoneware ducts (alternative)	21,835	9	3				
Do. with Howard conduits	25,367	2	10				
W. T. Glover & Co., Limited	24,006	0	0	and	23,551	0	0
W. T. Henley's Telegraph Works Co. ..	22,274	15	5	,,	24,871	14	11
Western Electric Company	22,885	6	9	,,	25,662	19	3
Siemens Bros. & Co., Limited	24,056	3	1	,,	27,858	11	8
Callender's Cable Construction Company ..	20,669	13	5	,,	24,509	10	10
J. G. White & Co.	26,873	0	0				
Do. with stoneware ducts only (alternat'e)	22,988	0	0				
St. Helens Cable Company	23,875	10	6	,,	26,102	0	1
W. F. Dennis & Co.	22,914	0	0	,,	25,395	4	9

At their meeting on February 4th, the Tramways and Parliamentary Committee reported that on the recommendation of Messrs. Lacey, Clirehugh & Sillar (engineers) they had decided to accept the tender of the Callender's Cable and Construction Company, Limited, at £20,669 13s. 5d., for cables, &c.

Bray.—Messrs. Witting Bros., Electrical Contractors, Limited, have received an order to supply a 75-KW. alternator (£275) for the electric light station.

Cleckheaton.—Messrs. Thornton & Crebbin, of Hammerton Street Iron Works, Bradford, have secured the order for two electrically-driven boiler pumps and one electrically-driven supply pump for the U.D.C. electric lighting station.

Heckmondwike.—The D.C. has accepted the tender of the Tudor Accumulator Company, Limited, for the enlargement of the battery at the electric lighting works.

Hornsey.—At the last Council meeting the tender of Messrs. John Spencer, Limited, for pipe work and valves, was accepted at £2,147, and that of the Temperley Transporter Company for mechanical coal-handling plant.

Huddersfield.—Messrs. Bolckow, Vaughan & Co., Limited, of Middlesbro', have secured contracts for the supply of materials to the Huddersfield Tramway Department as follows:—Rails, £6 7s. 6d. per ton; fish plates, £7 17s. 6d.; tie rods, £8 16s. 3d.; sole plates, £7 17s. 6d. per ton.

Hull.—The E.L. Committee has accepted the tender of Messrs. Siemens Bros. & Co. for the supply of cables for the next three years.

Liverpool and Garston Light Railway.—The contract for the three 153-H.P. dynamos for the above scheme has been placed with Messrs. D. Bruce Peebles & Co.

Middlesbrough.—The E.L. Committee has accepted the following tenders:—

Witting Bros., engine house plant	£2,833
Nalder Bros., switchboard	490
B.I.W. Company, mains	863

Newport (Mon.).—The Council have been reported to by Mr. Parshall, their consulting electrical engineer, upon a delay in connection with the contract for the overhead travelling crane for their new generating station. Mr. Parshall states that he has come to the conclusion that the contractors cannot be relied upon to complete the contract, and recommends that the same be cancelled and the work given to Messrs. Broadbent & Sons, Limited, of Huddersfield, whose tender was next lowest. The Council, after a lengthy correspondence with the contractors, in which the latter complained that they had great difficulty with Mr. Parshall over the drawings, have decided to adopt the course suggested.

Messrs. W. T. Henley's Telegraph Works Company, Limited, have written the Newport County Council objecting to one or two of the general conditions accompanying a tender of theirs for cables, which tender had been accepted by the Council. Messrs. Callender's Cable and Construction Company have also written in a similar strain. Both matters were referred to Mr. Parshall for him to deal with.

Swansea.—For extensions to their electric lighting plant, the Harbour Trustees have placed the following contracts:—

Robey & Co., steam engine	£1,585
Electric Construction Company, alternator	775

Wallsall.—At the meeting of the T.C. on Monday, the following tenders were accepted:—

T. Parker & Co., Limited, dynamo, spare armature and an exciting dynamo	£2,020
Messrs. Bumstead & Chandler, engines for the generating set and exciter	1,657
T. Parker, Limited, new switchboard frame	68

Warsaw.—Several of the daily newspapers report that Messrs. Peterson, Cooper & Co. (Paterson & Cooper ?), the British electrical engineers, have secured from the municipality of Warsaw contracts for an electric light installation, and for electric tramways and local railways having a total length of 60 miles. The orders had been given to a German firm, but were cancelled owing to the anti-Prussian agitation in Poland. The British firm secured the contract in competition with Belgian, French and American rivals.

West Ham.—The Guardians have given the contract for an electric lighting installation at the new infirmary to Messrs. F. A. Glover & Co., at £6,049.

Worcester.—The tender of the Alphons Custodis Company has been accepted by the City Council for a chimney for the new electricity works.

London.—The London County Council received the following tenders for the wiring, &c., of the Smack Boys' home at Lowestoft:—

Bush & Dryburgh (accepted)	£103 0 0
G. N. C. Mann & Co.	105 0 0
Jackson Brothers	122 16 0
The Anti-Vibrator, Limited	130 0 0
J. G. Statter & Co.	135 0 0
National Electric Wiring Company	139 10 0
Tyler & Duncan	149 0 0
Barlow & Young	165 0 0

London.—The Hampstead B.C. has accepted the tender of Messrs. J. Fraser & Sons, for additional condensing plant.

London.—The contract for the feeder and section pillars for the London United Tramways, Limited's extensions has been placed with the Electrical Transmission Company, of Hammersmith.

London.—The St. Pancras Borough Council received the following tenders for the supply of boilers, superheaters, pipes and feed pumps for the extension of the generating station in King's Road:—

Babcock & Wilcox (accepted)	£9,722
E. Danks & Co.	9,101
Tinkers, Limited (incomplete)	9,027
Stirling Boiler Company	7,284
J. Fraser & Sons (incomplete)	6,760
Climax Boiler Company (incomplete)	5,073

The Borough Council has accepted the tender of the Allgemeine Electric Company, amounting to £13,997, for the supply of engines, dynamos, three-phase generators, switchboard, &c., for the extension of the same generating station, the type of engine selected being those made by Messrs. Browett, Lindley & Co. The following is a list of the tenders:—

	Allen.	Browett & Lindley.	Belliss & Morcom.	Willans & Robinson.	Davey-Paxman.	Ferranti.	Parsons.	McLaren.	Sisson.	Westinghouse.	Combe-Barbour.	Dynamo makers.	—
The International Electrical Company	12,250	12,940	—	—	—	—	—	—	—	—	—	—	—
The Allgemeine Electric Company	12,840	13,997	16,267	15,458	—	—	—	—	—	—	—	—	—
The British Schuckert Company	13,634	14,364	18,450	16,428	13,780	14,396	—	15,825	—	—	—	—	—
Dick, Kerr & Co.	15,177	15,867	19,501	18,206	14,970	16,800	—	—	—	—	—	—	—
Mather & Platt	14,021	14,669	17,252	16,556	—	—	—	—	—	—	—	—	—
British Thomson-Houston Company	14,187	—	17,494	—	—	—	—	—	—	—	—	—	—
Combe, Barbour & Co.	—	—	Complete with boilers.				—	—	—	—	29,176	—	—
Siemens Bros. & Co.	14,760	—	18,160	17,552	14,636	—	15,957	—	—	—	—	—	—
												Siemens 17,200	—
McLaren	—	—	—	—	—	—	—	Own	—	—	—	Lahmeyer 16,680	Crompton 20,677
Davey, Paxman & Co.	—	—	—	—	Own	—	—	—	—	—	—	—	—
General Electric Company	—	—	19,172	18,039	—	—	15,030	—	—	—	—	—	—
Frank Suter & Co.	—	14,775	17,906	16,630	—	—	—	—	—	—	—	—	—
C. A. Parsons & Son	—	—	—	—	—	—	17,806	—	—	—	—	—	—
												Westinghouse 19,000	—
Sisson & Co.	—	—	—	—	—	—	—	—	Own	—	—	Siemens 14,850	Lahmeyer 14,380
W. H. Allen & Son	Own	—	—	—	—	—	—	—	—	—	—	—	—
Witting Bros.	—	—	17,353	—	—	—	—	—	—	—	—	Allgemeine 15,000	—
Ashton & Frost	—	—	—	—	—	—	—	—	—	—	—	—	—
Electric Construction Company	16,460	—	21,005	19,558	—	18,882	—	—	—	—	—	—	—
Lahmeyer & Co.	15,074	15,952	19,371	18,040	15,404	—	—	—	—	—	—	—	—
Crompton & Co.	17,328	—	—	19,974	—	—	—	—	—	—	—	—	—
British Westinghouse Company	19,768	18,0'8	17,353 / 22,808	20,858	—	—	—	—	18,808	17,308	—	—	—
Johnson & Phillips	14,837	—	17,931	17,767	14,898	—	—	—	—	—	—	—	—
Ferranti, Limited	—	—	—	—	—	16,598	—	—	—	—	—	—	—

Woolwich.—The M.B.C. has ordered 7,000 pairs of arc lamp carbons from Messrs. Oliver & Co. for £37 17s. 9d.

Yarmouth.—It is satisfactory to learn that the contract for the cars has not been placed abroad as in the case of the rails. The Brush Electrical Engineering Company have secured the order for the supply of 14 cars. Good progress is being made with the laying of the tram lines, and there is little doubt but that the lines will be ready for working in the early part of June.

FORTHCOMING EVENTS.

Friday, February 14th.—At 8.30 p.m. British Electro-Therapeutic Society meeting at 11, Chandos Street, W.

Monday, February 17th.—Institution of Electrical Engineers (Newcastle Section). Meeting. Paper by Mr. F. A. S. Wormull on "Equipment of a Modern Telephone Exchange."

Tuesday, February 18th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester Section). Meeting at Owens College. Paper on "The Construction of English and Foreign H.T. Central Station Switchgear," by Mr. H. W. Clothier.

At 8 p.m.—Institution of Civil Engineers. Paper to be read with a view to discussion: "Electrical Traction on Railways," by Messrs. W. M. Mordey and Bernard M. Jenkin.

Wednesday, February 19th.—At 7.30 p.m. Institution of Electrical Engineers (Students' Section) Meeting. Paper on "Electrical Equipment of Printers' Machinery," by Mr. E. W. Short.

Thursday, February 20th.—At 7.30 p.m. Institution of Electrical Engineers (Dublin Section). Meeting at the Royal College of Science, Stephen's Green. Paper: "Notes on Irish Water-Power and its Electric Development," by W. Tatlow, M.A.

Saturday, February 22nd.—At 12·15 p.m. Institution of Electrical Engineers (Students' Section). Visit to the Bankside Station of the City of London Electric Lighting Company, Limited.

At 7 p.m. Hartley College Engineering Society. Meeting at the Hartley College. Paper on "Polyphase Electric Currents," by Mr. Harris.

NOTES.

The Municipal Electrical Association.—We learn that the special general meeting of this Association, which we announced last week for 21st inst., is confined to members of the Association only.

Electrical Exhibition.—An electrical exhibition is being arranged by the Bermondsey Council on February 26th, 27th, and 28th, and firms wishing to exhibit should apply to Mr. W. H. Vincent, the borough electrical engineer, at once.

Institution of Electrical Engineers.—At the Glasgow sectional meeting on Tuesday, the discussion was continued on Mr. J. C. A. Ward's paper on "Practical Notes on Continuous Current Distributing Mains."

Before the Students' Section at Westminster on Wednesday, a paper on "Series Parallel Control," was read by Mr. J. B. Langford.

Yesterday evening before the London meeting of the Institution, the following matters were brought forward:—"Researches on the Electrical Conductivity and Magnetic Properties of Upwards of One Hundred Different Alloys of Iron," by Prof. W. F. Barratt, F.R.S., chairman of the Dublin Local Section, I.E.E., and W. Brown, B.Sc., Associate Member; and "On some Conclusions Deduced from the Preceding Paper," by Prof. W. F. Barrett, F.R.S., Member.

Before the Manchester Section on March 4th, Mr. Bertram Blount will read his paper on "Electric Furnaces," at the Owens College, Manchester. This paper was postponed from January 14th.

At the meeting of the Dublin Section on the 20th inst., Mr. W. Tatlow, M.A., B.E., will read a paper on "Irish Water Power and its Electrical Utilisation."

Business Announcement.—In answer to the numerous communications received, the directors of Electric Lighting Boards (British Manufacturing Company), Limited, request us to announce that all inquiries, correspondence, &c., should be addressed to the head office, at 7, Pall Mall, London, S.W., and addressed to the company as distinct from individuals.

Institution of Civil Engineers.—There is to be a discussion next Tuesday on a paper entitled "Electrical Traction on Railways," by Messrs. W. M. Mordey and Bernard M. Jenkin, M.Inst.C.E.

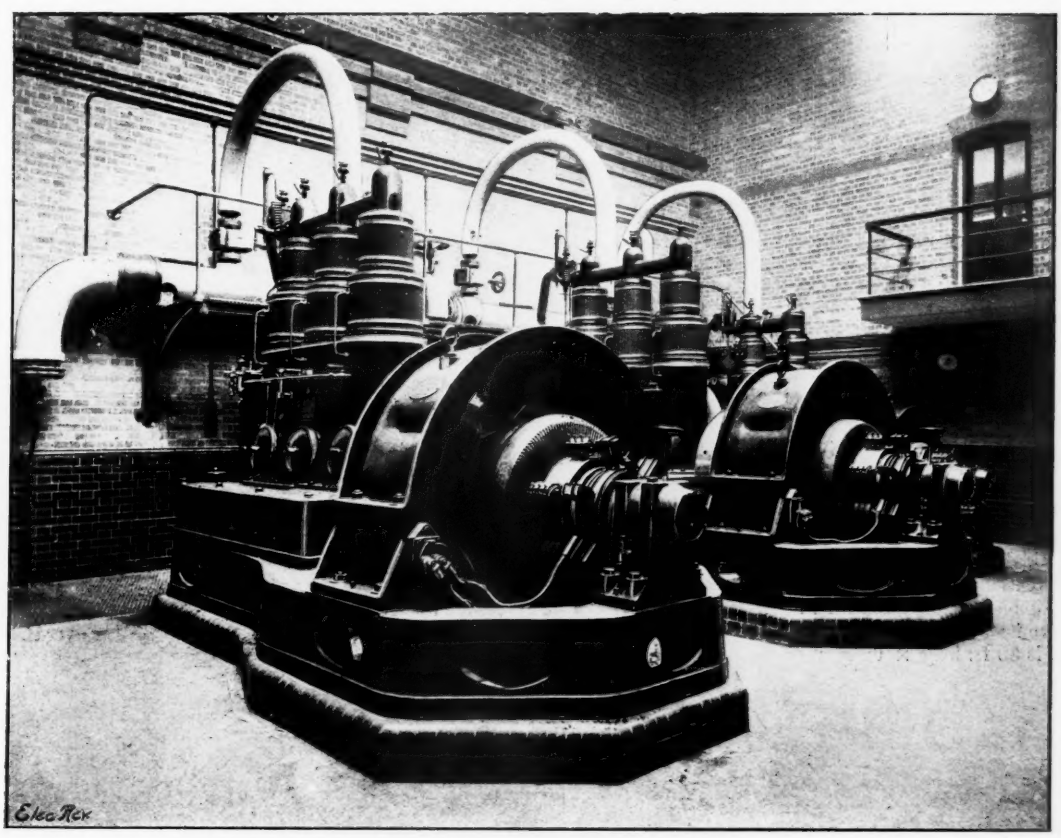
(*Continued on page* 268)

BERMONDSEY ELECTRICITY WORKS.

The parish of Bermondsey, one of the oldest and most widely known districts of the metropolis, has long been furnished with a supply of electrical energy, as it is included in the huge area over which the London Electric Supply Corporation possesses statutory powers, and is traversed by the trunk mains of that pioneer company. Nevertheless, the Vestry, filled with the modern spirit of progress, decided six years ago to embark upon the supply of electricity on its own account, with the result that a municipal electricity works was formally opened on the 23rd of last month, as recently chronicled in our columns.

This result was not arrived at without overcoming the most strenuous opposition, and surmounting extraordinary difficulties; in fact, the Vestry of Bermondsey was the first local authority to obtain powers to compete with a company already in possession of the field. The first steps were taken in 1896, when a committee was appointed to consider the matter; Messrs. Kincaid, Waller & Manville were appointed consulting engineers, and after their report had been submitted in 1897, it was resolved to apply for a provisional order. The application was opposed at the Board of Trade inquiry in 1898 by the London Electric Supply Corporation, and by the County of London and Brush Provincial Electric Lighting Company, who were also seeking powers in the parish; the Vestry's application was, however, granted. The confirmation Bill was opposed in Parliament, and was delayed in passing through the House of Commons, so that it arrived in the Upper House too late to become law during that session. Undeterred, however, the Vestry began again in 1898; a second inquiry was held in 1899, the same opposition being experienced, the order was granted, and in June, 1901, the Vestry, now a Borough Council, was rewarded for its perseverance by the Royal assent to the Bill.

A site was purchased adjoining the Town Hall and other municipal buildings in Limasol Street, a very central position with regard to the lighting area; provision was made for a refuse destructor to be worked in combination with the electricity supply undertaking. Plans and specifications were prepared by the consulting engineers, and the contracts were awarded as follows:—

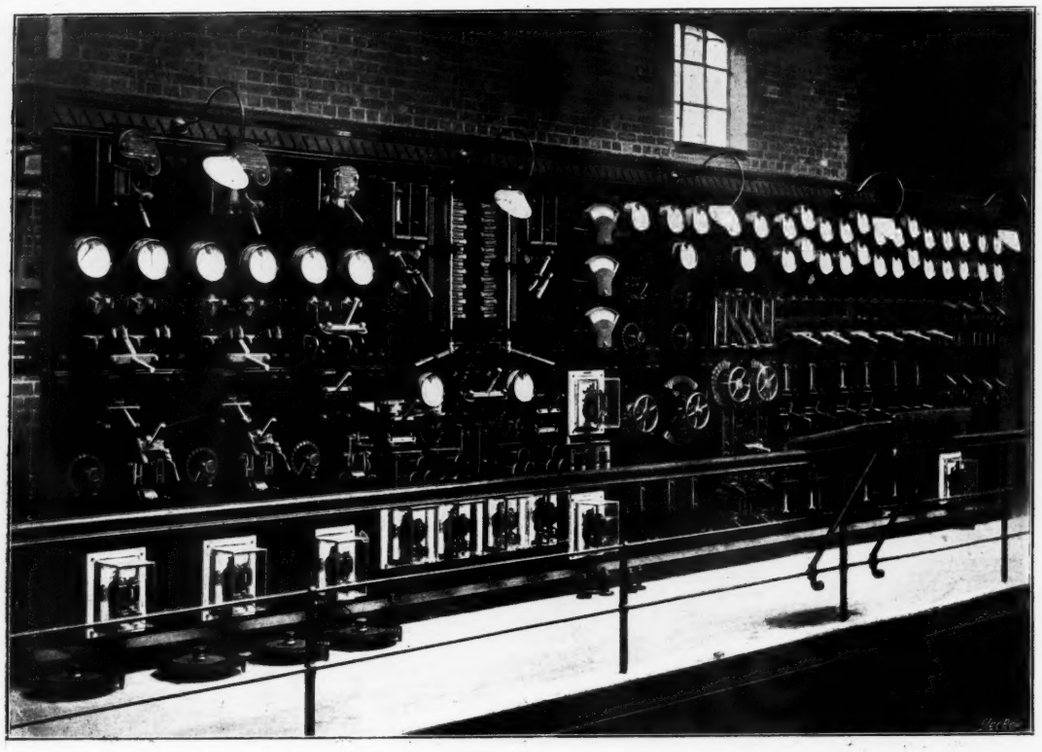


Bermondsey.—Generating Plant.

Buildings	Messrs. Todd & Newman.
Destructor, boilers, fans, economiser and chimney.	Messrs. Hughes & Stirling.
Dynamos, engines, balancer and booster.	Messrs. The Thames Iron Works Company.
Pipes, pumps, &c.	Messrs. Spencer, Limited.
Storage battery	Messrs. The Tudor Accumulator Company, Limited.
Switchboard and public lighting.	Messrs. Crompton & Co., Ltd.
Water softener	The Stanhope Engineering Co., Limited.
Artesian well	Messrs. W. Brown & Son.
Mains and conduits	Messrs W. T. Glover & Co., Limited.
Electricity meters	Messrs. Venner & Co.
Wiring station and buildings.	Messrs. The National Electric Wiring Company, Limited.

Mr. W. H. Vincent was appointed borough electrical engineer, and supervised the erection of the plant and the laying of the mains, in conjunction with the consulting engineers, Messrs. Kincaid, Waller & Manville.

The destructor was designed by Mr. A. J. Liversedge, and consists of six cells, each capable of destroying 10 tons of refuse per day. There are three Babcock & Wilcox single-drum boilers, working at 160 lbs. per sq. in.; each boiler has



Bermondsey.—Main Switchboard.

The buildings consist of engine room and destructor house, pump and fan room, battery room, and offices. The engine room measures 50 ft. × 39 ft., and is served by a 10-ton travelling crane, built by Messrs. Carrick & Ritchie. The room is well lighted from the roof, and a temporary wall of galvanised iron at one end provides facility for carrying out extensions. The foundations of the generating plant are based upon a concrete bed 8 ft. thick to minimise vibration, and the floor is paved with wood blocks. The destructor house is 80 ft. long × 62 ft. wide. The chimney is 150 ft. high, and 6 ft. 6 in. in diameter at the top, lined with fire-brick to a height of 50 ft., and surrounded at the base with a dust-separating chamber. A coal store capable of holding 230 tons is provided.

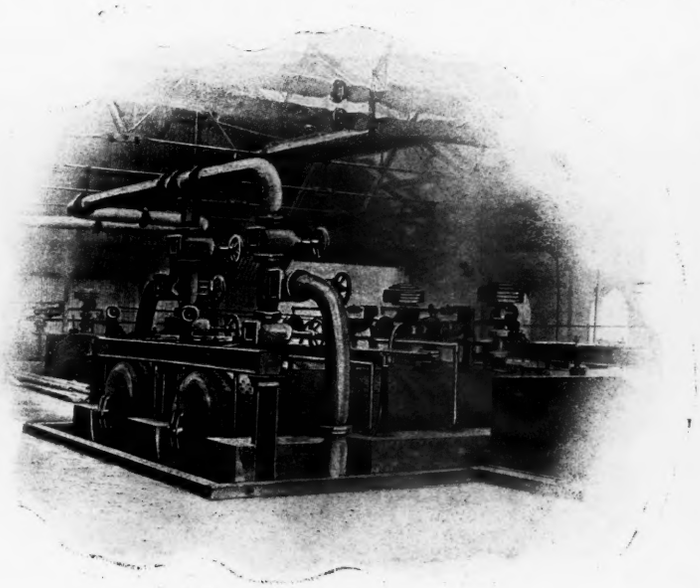
a grate area of 90 sq. ft., and a heating surface of 2,010 sq. ft. Dead weight safety valves and Hopkinson high steam and low-water alarms are fitted to all the boilers, as well as a steam jet to clean the tubes.

The refuse is brought in the collecting vans up an inclined roadway to a tipping floor, and is tipped into bins over the cells, whence it is shovelled as required through rectangular shoots upon a hearth at the back of the furnace; here it is dried, the vapours being cremated by passing over the hottest part of the furnace.

Bermondsey.—Balancer and Motor-Booster.

The flues and dampers are arranged in such a way that each boiler and cell may be worked independently of the rest, and the boilers may be fired with coal whether the destructor is working or not. The main flue is in duplicate.

Forced draught is provided by means of three fans, each designed to deliver 8,000 cub. ft. of air per minute under a head of 3 in. of water. The cells are also fitted with steam jets, which may be used if necessary. Two of the fans are driven through gearing by single-cylinder vertical Sheil



Bermondsey.—Boilers, from Tipping Platform.

engines. The third is coupled direct to an electric motor of 15 B.H.P., semi-enclosed, made by Messrs. D. Bruce Peebles & Co., and running at 700 r.p.m.

The feed pumps are of the differential compound type, made by Messrs. J. P. Hall & Co.; two are provided, each having a delivery capacity of 1,800 gallons of water per hour at boiler pressure. The steam and feed piping are in duplicate. The water supply is at present derived from the town mains, which feed a storage tank above the pump room, capable of holding 10,000 gallons; an artesian well is in course of construction. A water-softening plant, capable of dealing with 2,000 gallons of water per hour, has been installed, on the Stanhope system.

A Green economiser is provided, consisting of 200 tubes, with bye-passes and dampers; the scrapers are driven by a small electric motor.

The steam piping consists of a ring main, one leg of which is in the engine room, and the other in the boiler house; the boilers feed into the latter at three points, and stop valves are provided to divide the ring into sections when necessary. Large steam separators are also fixed on the mains between the boilers and the engine room.

The steam pipes are of wrought-steel, lap-welded, and the main valves are of the through-way pattern, with cast-steel bodies.

The generating plant consists at present of three dynamos, built by the Thames Iron Works Shipbuilding and Engineering Company, Limited, and coupled direct to Willans engines. Two of the dynamos are six-polar, and have an output of 150 KW. each at 480 — 520 volts, 385 r.p.m.; these are coupled to three-crank engines. The third set consists of a four-pole dynamo, of 75-KW. output at the same pressures, driven by a two-crank engine at 450 r.p.m. The steam consumption of these sets, when tested, was found to be below the guaranteed maximum consumption, so that the manufacturers became entitled to a bonus.

The frames of the machines are of an unusual type, being provided with flanges running round the yoke, which is divided in the horizontal plane. The magnet poles are cast with the yoke, and are traversed by a radial gap, passing completely through to the pole face. The frame and outer bearing are carried on a massive base-plate, upon which the engine bed-plate is mounted. The field coils are piled up in a pyramidal form.

The armature is of the usual barrel-wound type, with a clear space through the armature and commutator spiders, and the lubrication is of the automatic ring description.

The brush gear is of a novel pattern, the carbon brushes being curved radially, and lying on a correspondingly curved support.

The branches from the main steam pipe to the engines are single, and are taken in smooth curves of large radius from the upper side of the main pipe, so as to assist in separating water from the steam, and to provide an elastic connection with the engines. The exhaust pipe is underground.

The auxiliary electrical plant consists of a balancer and a motor booster. The former is composed of two similar machines coupled together, of the two-pole overtype, rated at 15 KW. each, and running at 800 revolutions per minute. The booster set is used for charging the storage batteries, and consists of two boosters, each rated at 8 KW. (80 amperes at 10—100 volts), driven by a motor placed between them and running at 800 revolutions per minute. These machines are fixed under the switchboard gallery.

Provision is made for using the boosters both to charge the batteries and to assist in discharging them.

The batteries are arranged in two sets of 140 each, and are of the Tudor L.B. 11 type, in glass boxes. Their combined capacity is 83 amperes at 510 volts for six hours, or on emergency 300 amperes for one hour. The battery leads

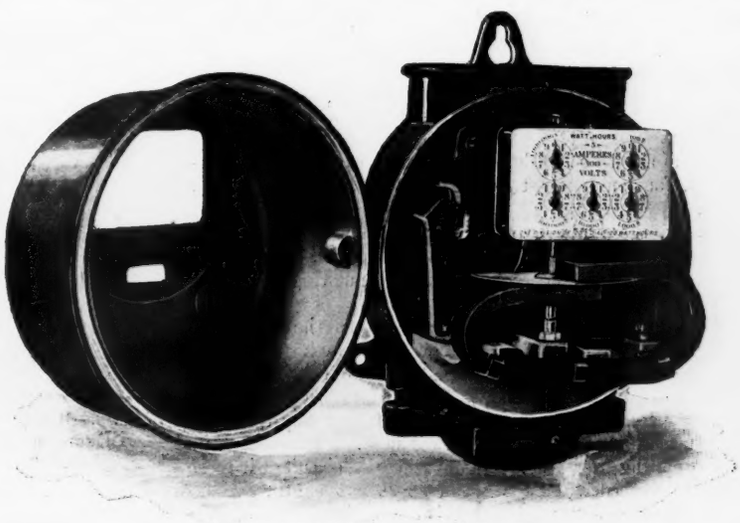


Fig. 1.—Single-Phase Westinghouse Integrating Wattmeter with Cover Open.

are insulated with india-rubber and lead-covered. A portable "milking booster" is provided for charging individual cells.

The main switchboard was supplied by Messrs. Crompton and Co., Limited; it is mounted on a lofty gallery, and

consists of enamelled slate panels carried in a wrought-iron frame

There are three generator panels, each equipped with a British Thomson-Houston circuit breaker, ammeter, paralleling voltmeter, and double-pole main switch. A shunt breaking and discharge D.P. switch interlocked with the main switch, rheostat, Siemens zero current cut-out, fuse and ammeter, are also provided.

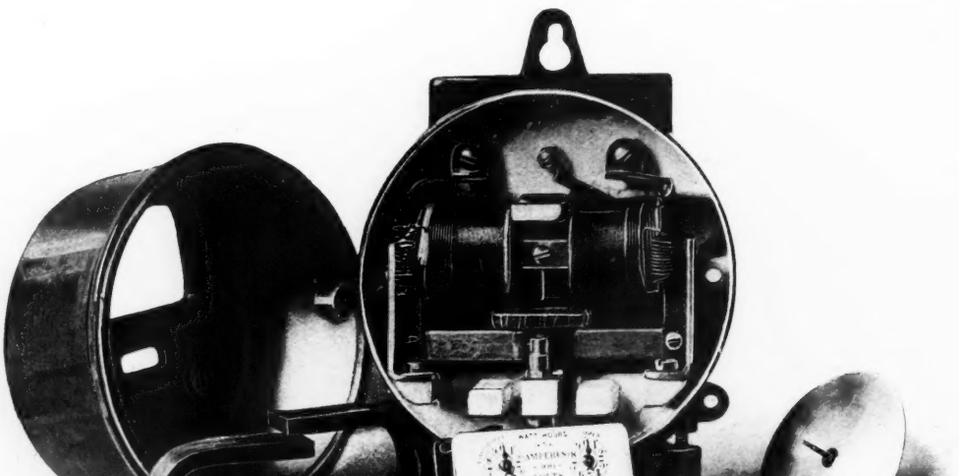


Fig. 2.—Single-Phase Westinghouse Integrating Wattmeter with Counting Train, Permanent Magnet and Disc Removed.

Each of the battery panels carries a 16-way regulating switch of the vertical type, fuses, and booster switches. A D.P. main switch and fuses is mounted partly on each panel. A charging ammeter, field break and reversing switch, booster rheostat, and two T.H. watt-hour meters with plug bars, for measuring the charge and discharge, are also fixed on each of the battery panels.

The measuring panel is equipped with two watt-hour meters with plug bars, and three voltmeters with illuminated dials.

The balancer panel is fitted with three ammeters on the three wires, field rheostat, double starting switch and fuses, and a starting switch for the booster motor.

A special panel is set aside for lighting the Town Hall and other buildings, from either the bus bars or the battery at will. It is fitted with two ammeters, a voltmeter, throw-over switch and D.P. fuse, and a number of circuit switches.

There are three feeder panels, each carrying two voltmeters, four ammeters, two D.P. switches, and four duplex fuses.

Lastly, there are two arc panels, each equipped with four ammeters; each of the eight arc circuits is also provided with a D.P. switch and fuse, a regulating resistance, and a watt-hour meter.

All the instruments on the board (except the watt-hour meters) are of Messrs. Crompton & Co.'s moving coil type. The feeder voltmeters are of the compensated type, so as to indicate the pressure at the feeding points without the use of pilot wires; we are at a loss to understand why this well-known method is not more generally used.

Regulating resistances are provided in circuit with the Town Hall feeders, on account of their short length.

The middle wire earth panel is placed below the switchboard gallery, and is equipped with an Elliott recording ammeter, Crompton ammeter and cut-out, and plug bars.

The supply mains are laid on the three-wire system, with a declared pressure of 240 volts. Four feeders have been laid, of the triple concentric lead-covered type, insulated with diatrine paper and lead covered, made by Messrs. W. T. Glover & Co., Limited. Three of these have a cross-section of 0·125 sq. in., and the fourth is of 0·25 sq. in. A fifth feeding point is provided near the generating station. Each feeder is about 0·6 mile in length, and is led into a feeder pillar fitted with three three-pole switch cut-outs on a slate base insulated with oil, to which the distributors are connected. By this means very convenient access to the distributors is obtained, and provision is also made for connecting an indicator in circuit with any distributor, so as to ascertain the maximum demand upon it. The distributors, like the feeders, are of the triple-concentric type; the latter are drawn into Doulton conduits, while the former are laid on the solid system in earthenware troughing.

The public lighting at present comprises 71 10-ampere double arc lamps, of the Crompton type, arranged, for the most part, in series of 10 each. Each lamp-post is also fitted with two 16-c.p. lamps, switched on at midnight, an isolating switch, and an "Edmunds" automatic switch.

The reception accorded to the municipal supply has been very encouraging, and already there are 6,000 8-c.p. lamps connected. Numerous industries flourish in Bermondsey, and there is strong reason to believe that owing to the ever-increasing value of land and taxation on the north side of the river, many large factories will in the near future be transferred to the south side, where these important considerations are less burdensome. Moreover, large railway stations and depôts are included within the lighting area. The Borough Council, whose authority extends over the adjoining parish of Rotherhithe, is seeking powers in the current session of Parliament to supply electricity in that district also, a district largely composed of docks and wharves, where a considerable demand for both power and lighting is certain to be developed within no long period of time.

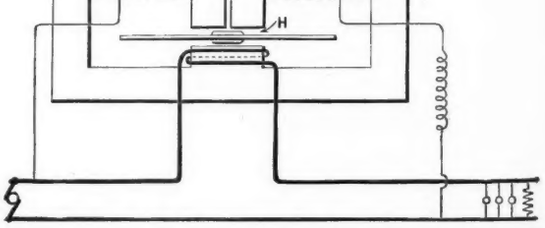


Fig. 3.—Diagram Showing Electro-Magnet and Electrical Circuits of the Westinghouse Integrating Wattmeter.

Up to the present the supply of steam from the destructor has proved more than sufficient to satisfy the requirements of the electricity works; though, of course, this cannot be the case for very long, it necessarily implies a very appreciable saving in cost of fuel both now and in the future. Plant has been put down by the Council for the purpose of manufacturing paving flags from clinker, and for other purposes, leading to an additional economy.

Mr. W. H. Vincent, M.I.E.E., the borough electrical engineer, previously occupied a similar position with the Town Council of Ashton, where he initiated important improvements, both in the electricity works, and in the refuse destructor, which are now in process of completion; his experience, therefore, will be especially valuable to the Borough Council in ascertaining in the shortest possible time the best and most economical system of working the combined undertaking. His assistants are Mr. J. W. A. Binnor and Mr. J. Hawes. We are indebted to Mr. Vincent for the opportunity of photographing the plant, and obtaining the particulars embodied in this article.

THE WESTINGHOUSE INTEGRATING WATTMETER.

It is doubtful whether any single accessory of electrical engineering has been accorded so much of the inventor's zeal and research as has the electricity supply meter. Ever since the supply of electricity became a commercial business the production of a supply meter which would indicate the quantity of energy consumed by a customer, and not simply the amount he had to pay for, has been sought. The result is that electric meters of all types, sizes, weights and shapes have been put forward from time to time. All known properties of electricity have been tried in these meters. Some are based on the heating effect of the current, others on electrolytic action, and others on electro-magnetism. Those working on the last-mentioned principle have gradually asserted their superiority, and recent efforts have been directed almost solely to its perfection. It would, no doubt, be of considerable interest to trace out the gradual development of meters, but such, to be complete, would require quite a volume, and, incomplete, would be of little value.

This article is devoted to a description of a modern type of electricity supply meter, and in view of the fact that the electricity meter is to-day as much a subject of interest to the general public as to the electrical engineer, will no doubt prove to be of service to many. The Westinghouse integrating wattmeter is a recent invention, but although the meters have been on the market only for a very short time, they have already gained wide popularity. It is an alternating current meter, and gives accurate records direct in Board of Trade units.

The construction of the meter is shown in the foregoing illustrations, which indicate the extreme simplicity of its parts; as a matter of fact, the superiority of the meter is entirely owing to its being of a design which combines the accuracy of a delicate electrical laboratory instrument with a strong and portable mechanical structure. The meter is practically a form of alternate current induction motor in which the primary circuit is fixed, while the secondary rotates at a rate directly proportional to the real power of the primary circuit.

The primary consists of an electro-magnet of the shape shown in fig. 3. It consists practically of two horse-shoe magnets, the two lower poles of which are combined to form one pole, while the two upper poles remain apart, divided by the small vertical gap V. Into the horizontal gap H, between the lower pole and the two upper poles, projects a disc, which forms the secondary and moving part of the meter. The secondary consists simply of a small light disc mounted on a short spindle, the upper end of which, as is usual, engages with a train of recording wheels, while the lower end rests in a jewelled step. There are no rotating coils or wires, and current does not require to be led into the rotating part. There are thus no moving contacts, commutators, &c.

The windings of the primary consist of a series coil, shunt coils, and compensation coils. The lower combined pole carries the series coil. The shunt coil is split into two portions, one being wound on each of the upper poles; they are so connected as to magnetise the core as a continuous ring, the magnetic flow passing across gap V. The small short-circuited coil, C, is to compensate for running friction. It is adjusted to give a condition in which the secondary will just not revolve when the shunt coil alone is in circuit at its maximum voltage. The rotation of the disc is retarded by a permanent magnet, as is usual in several older types of meters. The magnet is carried on slides by which its position with regard to the disc can be adjusted.

The series coil consists of a few turns of thick insulated wire coupled direct in one of the mains of the external circuit. The shunt coil is in series with an inductive resistance consisting of a fine wire coil wound on an iron core fixed in the base of the meter, the object being to secure a phase difference between the shunt and series currents of the meter, so that a shifting field can be obtained to rotate the secondary. As is well known, the phase difference should, if possible, be 90°, and the shunt circuit is adjusted to give this difference with an ordinary incandescent lamp load or other practically non-inductive load on the external circuit.

The series current and the shunt current differing from each other by a quarter of a period, the effect is to produce a shifting magnetic field of varying intensity across the horizontal gap, H. Taking the effect over a complete period, with the series current at zero, the shunt current is a maximum and the core is magnetised as a simple ring, the magnetic flux passing across the small vertical gap, V, and there being no flow or only a very slight leakage across gap H; as the series current rises in value and the shunt current is decreasing, a field is produced between the lower pole-piece and one of the upper pole-pieces; the magnetic flux is thus restricted to one side of gap H. This field rises in intensity to reach a maximum when the series and shunt currents are both positive and equal in value. From this point the shunt current decreases to zero, and the series current reaches its maximum positive value, when the flux becomes even between the lower pole and both the others, there being a uniform field across gap H, and no flow across gap V. As the series current decreases from its maximum positive value, the shunt current is rising from zero to a negative value, and the flux gradually shifts along gap H until, when the series and shunt currents are equal and opposite in value, the flux is concentrated between the lower pole and the other upper pole. From this point the shunt coil rises to its maximum negative value as the series current descends to zero, and thus there is no magnetic flow through H, but the core is again magnetised as a simple ring by the shunt coil, the total flux passing across V. This cycle is repeated through the other half of the period, the only change being the change in direction of the magnetic flow, and the whole is continuous, period by period. It will be seen, therefore, that the field across gap H changes from zero to a gradually increasing flux at one side between the lower pole and one of the upper poles, then spreads evenly over the gap, and then concentrates between the lower pole and the other upper pole, the field thus shifting repeatedly from one side of the gap to the other. The effect of the shifting field is to cause the disc to rotate, operating on the well-known principles of the induction motor.

The meter measures the true energy supplied to the external circuit under all conditions of inductive or non-inductive load. It will be seen from this description of a single-phase meter that the same principle is easily adaptable for polyphase meters. They are manufactured for two-phase and three-phase circuits, and in all cases record the true energy of the circuit whether the phases are balanced or not, and under all conditions of power factor. This feature is particularly important, and forms one of the most noteworthy improvements in meter practice exhibited by the Westinghouse meter.

The meter, whether for single-phase or polyphase circuits, is light, small and portable. It is enclosed in a dust, insect and moisture proof case, sealed by the manufacturers, who are thus enabled to guarantee its operation. The moving parts are neither clamped nor packed separately, but the meter as sent from the works is ready for immediate use. The terminals are in a separate small enclosed chamber at the top of the meter, the lid of which can be sealed by the supply company; thus the meter connections can be readily made without liability of damage to the meter parts. No multiplying constant is required, the meters recording direct in watt-hours or kilowatt-hours. They are calibrated very accurately, and the accuracy of their records is maintained over the entire range of the meters, and is said to be permanent. With regard to the range of the meters, they are guaranteed to commence recording with a load of one-half of 1 per cent. of their rated full load capacity. They have, moreover, an overload capacity of 50 per cent. above their rated capacity, and the accuracy of their records, we understand, is maintained right up to this degree of overload.

A novel feature in connection with these meters is that they are, in all sizes, designed so that when running on their rated full load circuit, the disc rotates at the rate of 50 r.p.m. At other loads the rate of rotation is directly proportional up to the point of 50 per cent. overload when, of course, the disc will rotate 75 times per minute. The knowledge of this fact enables any customer, not having means at hand for calibrating the supply meters, to readily check with fair accuracy the records of the meters. The losses in the meter coils are very low. In meters working on 100-volt to 200-volt circuits the loss in the shunt coil does not exceed from 1¼ to 1½ watts. The loss in the series coil of a 5-ampere meter at full load does not exceed 0·5 watt; this loss would, of course, be less in larger-sized meters. The makers guarantee that the total full load loss in a 5-ampere single-phase meter does not exceed from 2½ to 3 watts.

Electrical accuracy and permanency of calibration, combined with a strong, simple and well-finished mechanical construction, are some of the more important features of the manufacture of this meter, and judging by the extent to which the meter is being adopted, the makers have succeeded in producing a supply meter possessing points of such marked superiority as to lead one to expect that it will rapidly take a place in the front rank for alternate current working.

Liverpool.—At a meeting of the Liverpool City Council last week the chairman of the E.L. Committee reported that there had been a large increase in the profits both from lighting and power supply during the year. Private consumption for lighting had increased 24½ per cent., and the consumption for power 69 per cent. The Corporation supply had increased 22½ per cent. for lighting, and 36 per cent. for power. The receipts had amounted to £168,500, and the expenditure to £85,000.

NOTES.

(*Continued from page 262.*)

Electrical Contractors' Association (Liverpool).—A meeting of the electrical contractors of Liverpool and District was held last Friday at the Bradford Hotel, with the object of forming a trade association. Mr. Bland, A.M.I.E.E., of Newcastle, president of the Northern Section of the National Association of Electrical Contractors, gave an able and interesting address on the objects of the association. An enthusiastic discussion followed, principally on the injustice of municipal competition by the Liverpool Corporation, and also protesting against manufacturers and supply houses supplying goods and giving full trade terms to persons who are not legitimate contractors. A resolution was unanimously passed that "The electrical contractors here represented form the nucleus of an association, to be affiliated with the Northern Section, and to be called the Liverpool and District Association of Electrical Contractors." A chairman and committee of 20 were appointed *pro tem.* to deal with the business, with Mr. G. J. Harford, 47, Tithebarn Street, Liverpool, as hon. sec. The next meeting will be held on February 14th, at 7 p.m., at the Bradford Hotel, Liverpool.

L.C.C. Clauses.—At Tuesday's meeting of the L.C.C. the Highways Committee reported having had under consideration specification and forms of tender for the supply of the stoneware ducts required for the feeders and mains in connection with the reconstruction of the tramways. It had been represented that the Council's clauses relating to wages and hours of labour were inapplicable in this instance, owing to the special nature of the work, and the conditions obtaining in the trade as regards the payment of workmen. A special clause was inserted in the contract for rails, and the Committee suggested that a similar clause should apply in all contracts for stoneware ducts for the tramways. The Committee, therefore, recommended the Council to agree to the insertion of the following clause:—

> All wages to workmen for work executed by the contractor under this contract shall be paid by the contractor at the rates arranged between the employers and workmen in the pottery trade in that part of the country where the order is placed. The Council reserves power to cancel this contract so far as relates to any part of the work, not delivered and taken over at any time, on one week's notice, should it be proved to the satisfaction of the Council that lower rates than the said arranged rates have been, or are being, paid in the execution of this contract.

The consideration of the proposal was adjourned.

Berlin Railways.—It is stated that the Electric Elevated and Underground Railway in Berlin will be opened to general traffic on the 18th inst.

Plant for Sale.—The Newcastle upon-Tyne Electric Supply Company are advertising for disposal the plant installed at their Pandon Dene station, including Robey engines (300 to 550 I.H.P.), Mordey Victoria alternators (100 to 300 KW.), Lancashire boilers with mechanical stokers, Green's economiser, and a number of transformers. The plant is stated to be in first-class condition, and is only to be disposed of in consequence of the recent change in the company's system, and the erection of the Wallsend generating station.

Progress Sure to be Made Now!—A New York telegram says that a New Jersey Company has just been formed with the name of the Great Britain Railways Development Corporation, to build or purchase electric lines in England in places where the transit facilities are inadequate or the equipment behind the age.

American Fires.—The U.S. has had another of its big fires, this time at Paterson, where the blaze was set going at the Trolley Company's car shed. The electric lighting works and gas works were both burned down, and there was a complete breakdown of telegraphic and telephonic communication, but these apparently are among the smaller details. Churches, banks, newspaper offices, Christian associations, hotels, and public libraries, have all alike perished.

Artesian Well Pumps.—In our description of the South London electricity works last week we stated that the artesian well was sunk by Messrs. Isler & Co. This, we understand, was an error. It was sunk, on the advice of Mr. W. H. Booth, by Messrs. Dunn & Booth. The air lift pump was, we believe, erected by Messrs. Isler & Co, to give 6,000 gallons per hour, the comfortable yield of the bore-hole. Though air lift pumps have the disadvantage of requiring considerably more power to work them, they have the advantage that they will give the maximum yield of a bore-hole. To obtain 6,000 gallons of water from a well such as that of the South London electricity works would require an 8 in. deep well pump in a bore-hole of 10 in. diameter. But if the amount is there to be picked up a 6 in. well will yield the supply. The air lift principle can, however, only be applied when the well is deep enough to permit of the air pipes being carried down nearly twice as far below the level of the water when it is being pumped, as this level stands below the point of delivery. Thus if the pumped level is 100 ft. below the point of delivery, the air pipes must reach, say, to 300 ft. It is also important that the rising main of an air lift pump should not be too large, or the action of the pump will be wasteful and intermittent.

Institution of Junior Engineers.—At a meeting held at the Westminster Palace Hotel on February 7th, a paper, "The Electric Passenger Elevator," was read by Mr. William J. Cooper.

Society of Arts.—On March 5th Mr. E. Price Edwards is to lecture on "Sound Signals."

On March 19th Prof. S. P. Thompson will lecture on "Optotechnics"; and at a later meeting Mr. J. Clifton Robinson will deal with the subject of "London Tramways."

On Wednesday, 12th inst., Mr. W. L. Madgen lectured on "Industrial Re-distribution and its connection with the Overcrowding Question."

The South-Western Railway Company and Electric Tramway Competition.—Lieutenant-Colonel H. W. Campbell, speaking at a recent meeting of the London and South-Western Railway Company, referred to electric tramway competition. He said that, as their decrease in the third-class traffic showed, they were, as nearly all railway companies were, feeling the effects of electric tramway competition in the suburban districts, not only of London, but of other large towns. With the advance which had been made in electric traction such competition was inevitable; but such competition ought fairly to be limited to crowded districts, and it would not be reasonable to allow it to extend beyond the immediate suburbs, or it would become a most improper and unfair competition. The districts beyond immediate suburbs had been built up by the railway, which had spent millions to provide transit accommodation for the public and which had provided their own roads, while the rates they had paid had largely built up the funds by which the highways, of which the tramway companies ask the free use, had been made. Either the railway companies ought, if tramways competition was to be extended, to be relieved of the burden of the passenger duty, and to some extent of the rates (the incidence of which should be in proportion to the service rendered), or the tramway companies should pay such a rental for the use of the roads as would cause a reduction in the rates, and thus to an extent reduce the burden of the railway companies. They should not fail to press these views on the Parliamentary Committee who dealt with any Tramway Bills they might have to oppose this session. So far as London traffic was concerned, they had deemed it expedient to issue third-class season tickets to certain stations in order to give the public the fullest inducement to continue to travel by their route. They were carefully watching the results of this with a view of extending the issue of such tickets should it appear expedient in the interests of the shareholders; but the portion of their loss which they could not well make up, or, indeed, prevent increasing, was that between the local suburban stations, which could not fail to be diverted by a constant service of tramcars along the public road.

Royal Society.—The Prince of Wales was formally admitted a Fellow of the Society on Thursday last week. After the customary ceremonial, H.R.H. listened to a paper on "Radial Activity and the Electron Theory," by Sir W. Crookes, and made a brief speech, in the course of which he expressed hearty sympathy with "that scientific study and research which now, more than ever, has become so important and essential in our national life."

Personal.—The Leeds Tramway Committee have decided to recommend the Corporation to appoint Mr. Jno. Bailie Hamilton, of Glasgow, as general manager of the City tramways at a salary of £900 a year. Mr. Wharam, who is retiring, though being relieved of active service, will receive his old salary until the end of 1903, so that, if need be, he will assist his successor.

Mr. Blackburn, who for some years has held the position of manager of the Electric Construction Works, Bushbury, has resigned; and he has been succeeded by Messrs. E. S. Moore and W. Bullock, as joint managers. Both have been associated with the works for some time.

Mr. R. G. Hazeel has been appointed electrician on the Barnstaple and Linton Railway.

Motor-inspector King, who is leaving the Sheffield Corporation electric tramways to take up a position on the Brighton tramways system was presented with a gold watch and chain by his old friends, the inspectors, motormen, and conductors, at Sheffield, the other day.

A marriage has been arranged, and will shortly take place, between Mr. P. V. Luke, C.I.E., late of the Indian Telegraph Department, and Mabel, youngest daughter of Mr. Frederick Clifford, K.C., of Collingham Gardens, South Kensington.

Mr. John Longdon, telegraph inspector, having retired from the service of the Midland Railway Company, after being connected with them and the Electrical International Telegraph Company for the long period of 54 years, was made the recipient of several presents, which consisted of a handsome clock and a pipe, and an umbrella for Mrs. Longdon, by his old friends.

Lectures.—Before the East of Scotland Engineering Association, at Edinburgh, on 3rd inst., Mr. R. A. Knibbs read a paper on "The Sykes Electro-mechanical Signalling System."

Mr. F. Salsbury, postmaster of Liverpool, delivered an interesting lecture on "The Growth of the Postal and Telegraph Service" before members of the Postal and Telegraph Temperance League, at Liverpool on Wednesday last week.

A course of lectures on "Alternating Electric Currents" is to be given in Leeds, under the auspices of the West Riding County Council, on the first four Saturday afternoons in March, by Dr. J. A. Fleming.

Concert.—The first smoking concert of the Electrical Wiremen's Association is to be held at the "Pine Apple," Buckingham Gate, on Tuesday evening next, 18th inst.

Niagara.—The Niagara Falls Power Company has, says our correspondent there, authorised the completion of the installation in Wheel-pit No. 2 of its great work in connection with the development of Niagara power. This wheel-pit is located on the company's inlet canal opposite Wheel-pit No. 1. It is 463 ft. long and approximately 180 ft. deep. It is to have 11 turbines, each of 5,000 H.P., installed near the bottom, and this will give the pit an output capacity of 55,000 H.P. When the pit was well under way the Niagara Falls Company placed orders in Philadelphia for six 5,000-H.P. turbines, and in Schenectady, with the General Electric Company, for the same number of 5,000 H.P. generators, which would give a partial development of the resources of the pit, or 30,000 H.P. Now, when the wheel-pit is about completed and the power house is being erected over it, the announcement is made that the additional five 5,000-H.P. turbines and generators are to be ordered at once. The contract for machines that will develop 25,000 H.P. is a big order. It means more work for the skilled hands of Philadelphia, while in another way it is significant of the fact that the Niagara Falls Power Company can look ahead and see where this wonderful and additional amount of power will be required. It is significant of a continuation of the country's industrial growth, for Niagara has become such an industrial centre that it is somewhat of a pulse of progress in the manufacturing line. When the installation in this second great slot in the earth is completed, the Niagara Falls Power Company will have at its command no less than 105,000 H.P. All the water that is used by the turbines in the development of this stupendous amount of power passes from the two wheel-pits to the Lower Niagara through a tunnel over a mile long, which is built about 200 ft. below the streets of the city. For all this distance it was cut through solid rock, and is lined with vitrified brick four courses thick. It is one of the greatest works of the kind ever attempted by engineers. That the methods of the Canadian Niagara Power Company are to be very similar to those of the Niagara Falls Power Company, in the development of the power of Niagara Falls on the Canadian side, is indicated by the fact that the Canadian Niagara Power Company has just purchased a tract of 300 acres of land above the Dufferin Islands and above the Clark Hill district. The land in question belonged to the Sutherland Macklem estate, and it is most desirably located adjoining the Victoria Park. It will be recalled that the development of the Canadian Niagara Power Company is located in Victoria Park, and that the agreement between the company and the commissioners of the park is to the effect that al lthe power generated in the great plant shall be transmitted and used outside of the park lands. Thus this tract of land recently purchased will make desirable sites for prospective great factories, which may find it advantageous to be located on the Canadian side instead of on the New York side at the Falls. It is very evident that when the Canadian Niagara power development is under way, the British markets will feel the effect of the development, because of the fact that the products of the plants there located will have access, duty free, to all of the British markets. This will mean eager competition in some fields, without doubt, but it remains for the development to fully indicate in just what lines the competition will be most severe. The property purchased may also be used as a site for an industrial village, similar to the Niagara Falls suburb of Echota on the New York side. This will make it possible for the workmen of the plants to secure comfortable homes at reasonable rentals.

St. Petersburg Exhibition.—English manufacturers are being strongly urged to take part in the British Exhibition at St. Petersburg in the coming summer. It seems to furnish an excellent opportunity for our manufacturers of all kinds of electrical machinery and apparatus to make a great effort to secure a better hold upon the Russian electrical markets, which are said to be a very promising field at the present moment. All who are in any way interested in this matter should write to the controlling spirit in the exhibition, Mr. J. H. Johnson, of 12, Voznisensky Prospect, St. Petersburg.

Appointments Vacant.—A telephone manager (£200 to £260) is wanted for Tunbridge Wells; resident engineer for Maidenhead at £150; assistant electrical engineer for Hampstead at £150; the Crompton and Royton U.D.C's. want applications from engineers to carry out systems of electric lighting and tramways; assistant lighting and tramways engineer for Southend at £150; shift engineer for Manchester at £150.

Submerged Electric Lamps.—In our issue of the 7th inst. a correspondent asked to be referred to any firm that can give any information regarding the above. Messrs. W. McGeoch and Co., Limited, of Glasgow, inform us that they have several times made portable submerged electric lamps for fishing purposes.

H.M.S. "Irresistible."—A successful trial of the electric lights and motors of H.M.S. *Irresistible*, lying at the Royal Dockyard, Chatham, took place on Wednesday. The *Irresistible* is a twin-screw battleship of the first class (armoured), 14,500 tons, I.H.P. 15,000.

THE CENTRAL STATION ENGINEER.

We are pleased to record the great success of the first Bohemian Concert held by the Cricket Club of the Charing Cross and Strand Electricity Supply Corporation. On Saturday night last, February 8th, a crowded hall and a most enthusiastic audience at the City of New York Hotel, Holborn, repaid the organisers for their strenuous efforts in providing an excellent entertainment. The cricket club is but one year old, and as is not unusual with infantile organisations, fell into debt in its first season. However, it is now relieved of its trouble, and has a good balance in hand to start on the forthcoming season. We wish every success to the cricket club of this important and enterprising corporation.

The Croydon electricity works staff held their annual dinner on February 5th, the borough electrical engineer, Mr. T. Minshall, being in the chair. The works, as our readers are aware, are now of considerable dimensions, and the chairman intimated that they could without much difficulty arrange to supply current wholesale to the proposed Brighton Railway if the promoters would let them know in time. The speeches, as usual, were few and far between, the gaps being filled by the musical members of the staff on various instruments. A feature of the evening was the presence of the vice-chairman of the Electricity Committee as a guest, emphasising the spirit of harmonious co-operation which has been an important factor in the history of the undertaking.

The South Shields Council have granted to Mr. G. Robertson, station superintendent at the Corporation Electricity Works, the sum of £25 for extra work incurred during the late vacancy in chief engineer's position; they have also granted an increase to Mr. A. G. Hiscock, mains superintendent, from £130 to £150 per annum, and to Mr. J. C. Petersen, chief clerk, from £2 to £2 5s. per week.

There were 57 applications for the post of resident electrical engineer to the Bray township, in place of Mr. T. Tomlinson, B.E. Mr. Wilkins (Dublin United Tramways, Ringsend station) was appointed.

Mr. C. Furness, the borough electrical engineer of Devonport, is one of three candidates selected for a similar post at Blackpool.

Mr. W. S. Mackrill, one of the assistant engineers at the Peterborough Corporation electricity works, having secured a position under Messrs. Allen, Son & Co. at the Queen's engineering works at Bedford, received a handsome present from his colleagues on his removal.

Mr. G. Nowlan has resigned his position as assistant engineer to the Harrogate Corporation, having obtained an appointment with the British Insulated Wire Company, of Prescot. At present, Mr. Nowlan is temporarily carrying out the duties of mains superintendent until the person appointed is able to take up the duties.

NEW COMPANIES REGISTERED.

Day's Adjusting and Locking Points Company, Limited (72,671).—This company was registered on February 4th, with a capital of £3,000 in £1 shares, to acquire from W. A. Day the benefit of certain existing inventions in relation to tramway and railway adjusting and locking points, and to carry on the business of railway and tramway constructors, railway, tramway, omnibus and van proprietors, and manufacturers of carriages, trucks, locomotives, accumulators, dynamos, &c. The first subscribers are W. A. Day, 27, Granada Road, Southsea, manufacturer, 100 shares; E. S. Main, 30, Pearl Buildings, Portsmouth, manager of building society, 100 shares; J. J. Johns, 184, High Street, Southampton, chemist, 100 shares; J. H. Corke, 101, Victoria Road North, Southsea, J.P., 100 shares; F. W. Day, 27, Granada Road, Southsea, clerk, 1 share; D. Cammans, 68, Duncan Road, Southsea, plumber, 1 share; and J. Dumbrill, 66, Castle Road, Southsea, dairyman, 1 share. Minimum cash subscription 1,000 shares. The number of directors is not to be less than three nor more than five; the first are William A. Day, John H. Corke, John J. Johns and Edward S. Main; qualification, £100; remuneration, £100 per annum and £100 extra for the chairman for each 1 per cent. dividend exceeding 10 per cent. Registered office, 39, Pearl Buildings, Commercial Street, Portsmouth.

P. and R. Storage Battery Company, Limited (72,715).—This company was registered on February 7th, with a capital of £6,000 in 10s. shares, to adopt an agreement with Allan & Adamson, Limited, and W. Peto, its liquidator, and to carry on the business of accumulator manufacturers, photographic apparatus manufacturers, makers of automatic machines, telescope and lens manufacturers, electricians, opticians, &c. The first subscribers (each with one share) are:—H. J. Day, 66, New Compton Street, W.C., electrical engineer; W. A. Carroll, 63, Spencer Street, E.C., electrician; C. Stolman, 11, Cubitt Street, W.C., engineer; F. W. Woodhouse, 16, Lawford Road, Kentish Town, N.W., clerk; O. L. Boyse, Finsbury House, Blomfield Street, E.C., secretary; E. Davis, Finsbury House, Blomfield Street, E.C., secretary; and W. H. Simpson, Finsbury House, Blomfield Street, E.C., clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the first are not named; remuneration as fixed by the company.

SUPPLY STATION ACCOUNTS.

Southampton Corporation Electricity Accounts.

The last published accounts for the electricity undertaking of the Southampton Corporation do not bear out the favourable anticipations in which we indulged a year ago. The increase in capital expenditure has entailed a larger financial burden, the augmented output has been sold at a lower average price per unit, and the costs have increased. Instead, therefore, of maintaining the position reached in 1899, the financial result is very much worse. Mr. H. F. Street has now taken up the management of the business, and judging by his record at Halifax, it is to be hoped that he may be able to accomplish the difficult task of turning back the tide and restoring the department to a position of meeting all its liabilities.

GENERAL STATEMENT.

	1899.	1900.	Inc.
Total capital expenditure ...	£90,529	**£115,638**	£25,109
Number of units sold	526,554	**1,063,124**	536,570
Number of lamps connected ...	35,000	—	—
Maximum load in kilowatts ...	580	**568**	−12
Gross revenue	£10,542	**£17,286**	£6,744
Gross expenditure...	£5,951	**£13,619**	£7,668
Gross profit	£4,591	**£3,667**	−£924
Average price per unit sold ...	4·70d.	**3·77d.**	−·93d.

The increase in output and revenue are not confined to any one source. Private consumers took by meter 524,730 units, and by contract 65 units, representing 524,793 units sold for £11,640, an increase over the previous year of 116,315 units and £2,402. The public lamps, numbering 74 arcs and 92 incandescents, took 114,205 units sold for £1,309, an increase of 22,197 units and £387, while the tramways took 424,124 units sold for £3,776, the increase being large, 398,056 units and £3,550. The average revenue has fallen nearly 1d., but, owing to the sum received for maintenance of the electrical equipment of the tramways, the figure from all sources has fallen only by $\frac{9}{10}$d. to 3·90d. per unit.

REVENUE STATEMENT.

	1899. Gross	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£10,325	4·70d.	**£16,707**	3·77d.	— ·93d
Meter rents	168	·03d.	**228**	·05d.	— ·03d.
Maintenance of tramway equipment.	—	—	**276**	·06d.	+ ·06d.
Sundry rents, premiums, and fees.	49	·02d.	**75**	·02d.	·00d.
Gross revenue ...	£10,542	4·80d.	**£17,286**	3·90d.	— ·90d.

In the costs, coal, repairs, rent, &c., and other expenses have increased. Coal and repairs are the most important, and taken together amount to nearly ½d. per unit. A considerable reduction in wages and a small downward change in oil, waste, &c., leaves the works costs at just under 2⅝d., or over ½d. above the figure for the previous year. This figure is practically reproduced in the total cost. A sum of £526 was paid for hire of a Westinghouse engine, and this will, no doubt, be eliminated from the next accounts issued.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal	£3,271	1·49d.	**£7,332**	**1·66d.**	+ ·17d.
Oil, waste, water, and engine room stores.	264	·12d.	450	**·10d.**	− ·02d.
Salaries and wages incurred in generation and distribution.	859	·39d.	1,153	**·26d.**	− ·13d.
Repairs and maintenance of engines, boilers, buildings, dynamos and street lamps.	524	·24d.	1,966	**·44d.**	+ ·20d.
Maintenance of tramway equipment.		—	521	**·12d.**	+ ·12d.
Works costs ...	£4,918	2·24d.	**£11,422**	**2·58d.**	+ ·34d.
Rent, rates and taxes ..	126	·06d.	350	**·08d.**	+ ·02d.
Management expenses, salaries of managing engineer, secretary, clerks, audit fees, &c.	647	·29d.	909	**·20d.**	− ·09d.
General establishment charges, stationery and printing, law charges and insurance.	232	·11d.	412	**·09d.**	− ·02d.
Other expenses, stamp duty (1899), hire of engine (1900).	28	·01d.	526	**·12d.**	+ ·11d.
Total costs ...	£5,951	2·71d.	**£13,619**	**3·07d.**	+ ·36d.

The financial position can be readily explained. Owing to the large increase in costs, the gross profit has fallen by £924. To this has to be added the additional call for interest and sinking fund payments, amounting to £2,014, making £2,938, which swallows up the small profit in 1899 of £145, and leaves a net loss of £2,793.

PROFIT STATEMENT.

	1899.	1900.
Interest on loans	£2,391	£3,309
Sinking fund for repayments	2,055	3,151
Net profit carried forward	145	−2,793
Gross profit	£4,591	£3,667

CITY NOTES.

St. James's and Pall Mall Electric Light Company.

MR. EUSTACE BALFOUR presided at the annual meeting of this company at Carnaby Street Station on Tuesday, and in moving the adoption of the report, which was published in our last issue, he called attention to the excellent position of the company and to the results of the year's work. A distribution amounting to 14½ per cent. was to be made on the ordinary shares, so that the dividend had been maintained steadily at that rate for the last five years. The increase in the business had been fully maintained, and the equivalent of 25,480 8-C.P. lamps had been added during the past year, making a total at the end of the year of 211,827 8-C.P. lamps. It was not only the increase, but the rate of increase that was important. The accounts showed the same very satisfactory position. There had been necessarily a large addition to capital expenditure to complete the extensions at Carnaby Street Station. The year 1901 was far from favourable to the company's business. The price of coal was abnormally high, the additional cost under that head being no less than £4,000. The increase in rates laid upon the company a fresh burden of £3,175. Those two items, in spite of the economy in other directions, accounted for the increase of generating costs by about ½d. per unit. The weather in 1901 was, on the whole, very bright. Shareholders ought to feel satisfied at the continuous expansion of the business, which had enabled them, after setting aside a larger amount for depreciation, and adding to the reserve fund, to maintain the dividend and carry forward a larger amount than last year. The charge for rates was certain to increase, and although the price of coal had begun to fall they could hardly expect it to return for some time at least to the very favourable level of three years ago. The directors did not, therefore, at present see their way to reduce the charge for lighting, but they had felt themselves justified in offering their customers a substantial reduction on electricity for power purposes. They had no doubt that this portion of their business was capable of very large extension, and considerable orders for supply for motors had already been received. There was every reason to think that the use of electricity for such purposes would become general throughout greater London. The plant at the company's two stations would be sufficient to meet that increase of business until next winter, when the supply from the Central Electric Supply Company would be available, and thenceforward all further requirements would be drawn from that company, the electricity at high pressure being transmitted to this company from the new station at St. John's Wood, transformed to low pressure at Carnaby Street, and distributed to consumers in the usual way. The works of the Central Electric Supply Company at Grove Road were well advanced, and for shareholders' information an abstract of the accounts had been placed in their hands. The St. James's Company, in conjunction with the Westminster Corporation, took half shares in the construction and equipment of the Central works, and to that end each company had provided one-half of the ordinary capital in that company, and the St. James's Company had guaranteed jointly with the Westminster Corporation the payment of principal and interest on the issue of £250,000 4 per cent. guaranteed debenture stock of the Central Supply Company. To be able to do that, alteration was necessary in the memorandum of association of the company. The issue of debentures was made in July last, and was completely successful. All the advances made by the St. James's and Westminster Companies to the Central Company had now been repaid, and the interest received from the Central Company had been transferred from the suspense account to the credit of the capital and reserve fund. The chairman proceeded to refer to the Bill of the London County Council, which he said would, under certain circumstances, allow it to enter into competition with existing companies for the supply of electrical energy. The board were unanimous in their opposition to that Bill, which they regarded as most injurious and unjust to companies which had already been supplied with competition by Parliament, and were fulfilling their duty to their customers. They asked shareholders to use all their influence to support the directors in their endeavour to prevent such a measure passing into law.

The resolution was seconded by Mr. W. LEAF, and after a few questions had been put by Mr. FRY, and answered by the solicitor, it was carried unanimously.

The retiring directors were re-elected, and a vote of thanks was passed to the manager, engineer, and staff for zealous service during the year. In this connection Mr. Fry complimented Mr. Dobson that the loss in distribution showed such an enormous falling off; but Mr. Dobson said that they could not take all the credit for that. It was due to extending the feeder mains that, with judicious capital expenditure, they got that great saving.

Liverpool Overhead Railway Company.

SIR W. B. FORWOOD presided over the half-yearly meeting of this company on Tuesday.

In moving the adoption of the report, the CHAIRMAN said that it was with much regret that the directors had to appear before them with a statement which was disappointing, and that they had also to report that a sad accident through fire occurred on the evening of December 23rd, by which two passengers and four of the company's servants unfortunately lost their lives. From the opening of the railway nine years ago the first care of the directors had been to work the line with safety, and the fact that the trains had during this period run nearly 6,600,000 train-miles on a track only 6½ miles in length, and had carried 73,000,000 passengers without any serious accident until this, was a proof that the care they had taken had not been bestowed in vain, and the directors had, moreover, the satisfaction of feeling that the accident which they now had to deplore was due to no want of oversight. The motor which flashed was in every respect efficient, and had only very recently been overhauled. There were four methods within the control of the driver by which he could have cut off the electric current from this motor and at once extinguished the flash which caused the fire; the driver was a steady, experienced man, who had acted as driver since the opening of the line. They never before

had a case of fire arising from the flashing of a motor, and this was the best proof that their motors were well looked after and were under the perfect control of the drivers. It is satisfactory to be assured that no passengers would have lost their lives if they had not stayed to watch the fire. In re-constructing the station at the Dingle, which was successfully opened on Monday, they had substituted stone platforms for wooden ones, and as far as practicable the station had been rendered fireproof; they had adopted the May-Oatway system of fire detection; they were also gradually protecting their cars by the introduction into their construction of fireproof material in the vicinity of the motors. They were still awaiting the report of the Board of Trade Inspectors, and if they suggested any additional means of ensuring safety, the directors would, as far as practicable, carry them out. The company had the structure of the railway, the stations, the rolling stock, and the lives of their servants insured, but as they were substituting stones for wood and making other changes and improvements which they could not claim from the Insurance Companies, they had laid aside out of revenue £3,000 to meet these expenses. Two of their servants, Owens and the boy Gough, showed great courage and devotion to duty during the fire, and the directors intended to make to them a suitable presentation. The half-yearly report showed that as compared with the corresponding period of last year there had been a decrease of 356,659 passengers, representing a loss in money of £3,506, which was traceable to several causes:—(1) Tramway competition; (2) general slackness of trade at the docks; (3) diversion of the timber trade from the Canada Dock; (4) conversion of the Sandon Graving Docks into wet docks. The train mileage run amounted to 403,546 miles, being a decrease of 2,968 miles. They had maintained their good character for punctuality, 97·4 of the trains having kept their schedule times. Suggestions have been made that the line should be worked on the tramway system, *i.e.*, throwing the stations open and collecting the fares on the trains. The board did not see how this would attract additional traffic, and the extra cost would be £1,430 per annum. Another suggestion was that they should give an accelerated service, and the directors had very carefully considered that proposal. They could, by the construction of new trains driven by more powerful motors, make the journey from Seaforth to the Dingle in 20 minutes against 32 minutes, the time now occupied. This would be undoubtedly appreciated. The capital cost to equip trains and the line for this service would be £27,550, and the additional working expenses, exclusive of interest on capital, would be £437 per annum. They had already one accelerated train at work which they constructed as an experiment, and it was doing its work very well; but with a five-minutes' service they could not work one fast train only to advantage. The chairman then referred to a proposal to introduce 1d. stages. It might be that they would adopt an accelerated service together with the system of penny stages; but they could not do this without feeling quite sure of their ground. In regard to the working costs, the mileage was practically unchanged; the expenditure during the half year was £29,896 against £29,187 for the same half last year, an increase of £709. Upon maintenance of ways, works, &c., they had spent £4,216, against £4,480, or £264 less; they had placed aside, as usual, £1,500 for renewals, and had now to the credit of renewals account, £20,700. Locomotive power showed an expenditure of £8,212, against £8,104, or an increase of £108, although they saved £807 in the cost of coal. This increased expenditure was due to increased stocks of oil and tallow which last year had run down to a rather low point, and to large outlays in repairing armatures and general repairs at the generating station. Armatures were delicate pieces of mechanism; sometimes they would run for months, and at other times they had had as many as 10 to 12 under repair at one time, and they had this year had the addition of repairs to their tram motors. On repairs and renewals of carriages, they had spent £401, against £317, and the traffic expenses amounted to £11,348, against £10,638; the increase was due to special repairs to the signals which amounted to £145, and the maintenance of the large batteries at the generating station had cost £149 additional. There was again an increase in rates. They now paid £3,399 per annum, but the Liverpool trams paid nothing. The Waterloo and Crosby Tramways had worked satisfactorily. They had carried, during the half year, 1,032,484 passengers, representing an increase of 234,614 passengers, and £1,293 in money. The passengers had paid on an average 1·94d., as against 1·93d. the same half last year—the percentage of expenditure to revenue was 72·65, against 69·33, and the falling off in traffic, of course, increased that ratio. The expenditure per train-mile was 15·70d., against 16·24d.; the lowest expenditure was in 1894, 13·10d. The expenditure on the City and South London Electric Railway was 14·18d., being the lowest they had ever had, last year it was 16·44. The locomotive expenditure was 4·88d., against 4·28d., and their lowest was 3·25d.; on the City and South London it was 4·59d.

Mr. R. Hobson seconded, and the report was adopted unanimously. Resolutions declaring dividends, re-electing a director, and thanking the chairman, were passed.

St. Lawrence Power Trust.

According to a statement made at a meeting of the holders of the "A" certificates in London last week, the engineers had underestimated the cost of the Massena works undertaking, and had not anticipated some of the difficulties which presented themselves. It seems that when it was found that more funds were required to complete the works, Mr. Tait, of the firm of Mr. G. A. Touch, one of the trustees, happened to be in America, and he made a full investigation of the position. He found that the money expended had not been spent wastefully, and that the contracts were made on a cheaper basis than would be possible if they were entered into to-day. The question of the sale of power had engaged a great deal of attention, and they had been repeatedly disappointed in this respect. Two circumstances had prevented the conclusion of negotiations for the supply of power—the financial uncertainty of the company, and the fact that in June last they were compelled to pass the coupon on the first mortgage bonds. This meant, says the *Times* report, that the company were, at the moment, in default, and it was open to any creditor to initiate proceedings for foreclosure. It was not to be expected that any manufacturer would make a contract with the company for power when there was this liability of a foreclosure on the property. The plan of reorganisation, which had been arranged after consultation with representatives of the American bondholders, was of a simple character. It was proposed to wipe out the whole of the existing shares, to convert the first mortgage bonds into preference stock, and the second mortgage bonds into ordinary stock. This would leave the way clear for raising further capital by debentures. It would not be necessary to appeal to the English certificate holders to provide any part of the additional money required. The trustees believed that there was a great future for the undertaking, and that eventually it would earn good profits. Negotiations are now in progress which, subject to the reorganisation scheme being carried out, will probably lead to a great sale of power.

Resolutions were carried authorising the trustees to realise the securities at present held by taking foreclosure proceedings against the St. Lawrence Power Company, of Massena, and to join in a plan for the formation of a new company to purchase the property.

Marconi's Wireless Telegraph Company.

The report of the directors for the year ended December 30th last, to be submitted at the meeting on the 20th inst., states that Mr. Marconi continues, in a highly satisfactory manner, to develop his system of wireless telegraphy beyond the most sanguine expectations of the board, whilst, at the same time the commercial application of the system by this company and by its subsidiary undertakings is making rapid progress in all directions. The company now possesses a complete international organisation, having for its purpose the uniform adoption of the Marconi system in other countries on the same lines as it is established here. The chief event of the year, so far as the progress of the invention itself is concerned, occurred in December last, when Mr. Marconi, present at St. John's, in Newfoundland, received three wireless telegraphic signals from the company's station in Cornwall—a distance of over 2,170 miles across the ocean. This result was obtained in spite of adverse circumstances, the masts which had been erected for the permanent station having suffered severely from the winter gales. Steps have now been taken to build permanent stations both on the American and English shores, and the board anticipate with considerable confidence that this company will shortly establish regular wireless telegraphy across the Atlantic, available to the public at rates and conditions which need not seriously interfere with the welfare of the cable companies. These companies, on the other hand, should benefit by new traffic which the wireless telegraphy will bring to them from many hitherto undeveloped sources. The other main feature of the year has been the progress of the business of the Marconi International Marine Communication Company, Limited, in which the company is at present interested to the extent of £100,000, being one-half of the issued capital. This company was incorporated for the purpose of establishing international sea communication between ship and ship, and ship and shore, of all nations, and, with the help of a Continental group of financiers and others organised in Brussels, the establishment of Marconi's system of commercial shipping purposes is progressing satisfactorily in all directions. A formal agreement has also been concluded with Lloyd's, whereby that corporation has adopted Marconi's system exclusively in connection with their signal stations; the necessary instruments are now being installed at 10 of their stations, and these will also be worked for the passenger and commercial traffic of the Marconi International Marine Communication Company. The chief steamship companies are also giving orders for installations on their vessels; the Cunard Line, Norddeutscher-Lloyd, Compagnie Transatlantique, Beaver Line, Belgian Mail Packets, &c., &c., are regularly and successfully employing the Marconi system to the great satisfaction of the passengers and of the officers on these vessels. This example will doubtless soon be followed by other steamship companies. In other directions the company is also busily engaged. Many installations of wireless telegraphy have been carried out which are giving profitable returns to the company, either by royalty or by an interest in the receipts. Contracts have been entered into with various Governments, and negotiations are in progress for a number of other engagements of a beneficial character, which, however, it would not be in the interests of the shareholders to disclose at the present moment. The company as far as is practicable is itself working the apparatus for receipts as part of a general telegraph system, both alone and in connection with the existing ordinary telegraph systems. It is, so far, selling the apparatus only to Governments for naval and military purposes, and for lighthouse work, or to private persons for their private use. The company's factory at Chelmsford has been greatly improved, and the rapid extension of business has led to the establishment of a technical school for the special training required for the company's staff of operators. In view of the extreme value to the company of Mr. Marconi's services, the directors considered it right to take out an insurance policy on his life for £150,000 for three years. As to finance, it may be stated that since the date of the last balance-sheet 40,000

shares were offered for subscription to the shareholders at £2 per share, in order to provide the company with the necessary funds for the extending business.

The Liverpool Rubber Company.

THE report of the directors for the past year, shows that the profits on the year's working were £12,178 4s. 9d. A debit balance of £12,181 0s. 10d., was, however, brought forward from the previous year. Setting this against the profit, left a debit balance of £2 16s. 1d. to be carried forward. In keeping with the desire expressed at the last annual meeting, the allowance for depreciation has been suspended until the debit balance is disposed of, but tools and machines have been maintained in a state of efficiency.

Electric Lighting and Traction Company of Australia.

THE directors' report to be presented to the meeting at Winchester House, at 12 o'clock noon, on Monday, February 17th, reads as follows:—

The directors beg to submit the second balance-sheet and profit and loss account of the company for the year ended August 31st, 1901.

Revenue.—After placing the sum of £3,500 to reserve for depreciation, repairs and renewals, and writing off from the cost of the recent capital issue the sum of £1,489 9s. 5d., being the proportion of the Melbourne past profits earned prior to the incorporation of the company, the profit and loss account shows an available net profit of £7,771 9s. 4d., and the directors recommend that this sum be applied as follows:—

To reduction of loss incurred in starting the Adelaide undertaking	£500	0	0
To dividend on preference shares at the full rate of 6 per cent. per annum for year ended August 31st, 1901 ..	6,317	5	3
To balance carried forward..	954	4	1
Total ..	£7,771	9	4

Capital.—During the year, further capital expenditure in Australia on land, buildings, and plant, has been incurred as follows:—

On the Melbourne undertaking	£41,296	4	7
„ Geelong „	17,553	4	9
„ Adelaide „	40,894	6	2
Total ..	£99,742	15	6

In order to provide for the above expenditure, the capital of the company was increased in July, 1901, by the issue of the remaining £50,000 preference shares, and by the creation and issue at par of £75,000 5 per cent. debenture stock, redeemable at par in 21 years. Pending the issue of the remainder of the authorised capital, the directors have arranged with the company's bankers to advance the necessary funds for the further development of the company's undertakings. A resolution will be submitted to the shareholders at the general meeting, confirming this action.

Melbourne.—Formal completion of the purchase of the two Melbourne undertakings was effected on January 11th, 1901, since which date they have been under the sole control of this company. The anticipated administrative economies are being realised, and the business generally is developing satisfactorily. Although these economies are not yet complete, it will be seen from the profit and loss account that the net profit from Melbourne for the 7½ months' working from January 11th to August 31st, 1901, amounts to £9,802 16s. 9d. notwithstanding an increase of some 30 per cent. in the price of coal. The Melbourne undertaking is now being carried on under a new order in council granted to this company for a period of 25 years from November 13th, 1900, without prior right of purchase by the local authorities, and covering all the most important suburbs of Melbourne. The company's engineers report that a large demand for electricity for lighting, heating, and especially for power purposes, has sprung up in these hitherto untouched districts, and that the expenditure on additional plant and mains which has been, and is being incurred, is fully justified.

Geelong.—A permanent supply of electricity from the company's new works at Geelong was commenced in May, 1901, and has been taken up rapidly, there now being the equivalent of about 4,500 8-C.P. lamps connected to the mains. The result of the first four months' working shows that a small loss of £14 15s. 2d. has been incurred, but the expenses are now being covered by revenue, and it is anticipated that a profit will be shown in the accounts for the current year.

Adelaide.—The new station for lighting the city has been completed, and was opened in November, 1901. The equivalent of about 5,000 8-C.P. lamps are already connected, and applications for supply are coming in satisfactorily. The loss of £1,560 8s. 7d. incurred during the past year is principally due to the use of temporary generating plant, rendered necessary by the previous company's agreement with the Town Council. The starting of the new station has, however, enabled the temporary plant to be discontinued, with corresponding reduction in the working expenses.

Port Adelaide.—This small station again shows a loss on the year's working. The directors intend to close it down at the earliest opportunity, and supply the district by high tension current from Adelaide. Under these conditions they believe that the Port Adelaide undertaking is capable of earning a profit.

General.—The Stock Exchange granted an official quotation on March 4th, 1901, to the company's first issue of preference shares, numbered 1 to 20,000. Mr. A. U. Alcock has resigned his seat on the board. The directors do not propose to fill the vacancy for the present. The retiring director is Mr. J. F. Albright, who, being eligible, offers himself for re-election. The auditors, Messrs. Cooper Bros. & Co., also retire and offer themselves for re-election.

Anglo-American Telegraph Company.

MR. F. A. BEVAN presided at the meeting of this company held at Winchester House last Friday, and in moving the adoption of the report, he said that it was a matter of great satisfaction that, in spite of competition, and of the fact that during the year they lost the whole of the outward German traffic, which in past years constituted so important a portion of their receipts, they were able to declare dividends of the full amount upon the preference stock, and also to give a dividend, although a small one, to the holders of the deferred stock. The figures for the last half of the year showed that there was a decrease in the traffic of £2,760; the *Minia* receipts were £7,065 less than in the corresponding half-year, making a total decrease of £9,639; then there was an increase in working expenses of £2,779. On the other hand, the ship cost £9,395 less, and there was a diminution in law expenses and other small items, so that the net decrease on the half-year's working was £2,777, as compared with the corresponding period. The balance brought forward was smaller by £2,363, so that there was less divisible amongst the shareholders at the end of the year by £5,141. £24,000 was being placed to reserve, and after paying the dividends as stated in the report, £1,265 was carried forward. As to the decrease in the traffic receipts, there was a considerable decrease in the half-year in the Atlantic traffic receipts, and in some measure that was owing to a bit of ill-luck. In December last there was a very violent storm, which affected the northern parts of England, and the result was that the landlines connecting London and Valentia were broken down for some days. They had no control over this. It was not that the cables were at fault, it arose from the landlines breaking down, but it lost the company more than £2,000 of traffic. He believed that it cost the Post Office something like £50,000 to repair the damage caused by that great storm. On the other hand, though the Atlantic traffic had been less, they had derived rather more than usual from their local traffics, and particularly from the local traffic in Newfoundland, for which they were considerably indebted to Mr. Marconi, who, in his operations, somehow had to employ this company's lines to a considerable extent. Therefore, as far as he had gone at present, the company was indebted to him for a considerable use of the line. In regard to the large decrease of the *Minia* earnings, that was always an uncertain source of revenue, and it simply meant that their friends' cables were in such good working order that they did not need help to mend them, therefore the *Minia* was employed so much less; but there had been a decrease in the ship's expenses amounting to £9,395. As to the increase in expenses owing to salaries being raised by £2,300, he could hold out no hope that the working expenses, and especially salaries, were likely to decrease. Competition was increasing more and more. Not only had they the new cable laid from the Cape to Australia, but the Pacific cable was in course of construction, and would be laid in a few months' time; they would require a number of skilled operators, and, further, Mr. Marconi's company would ask for operators. The result was that there was a greater demand than ever for skilled operators, and if they were to maintain their working and keep up to that high standard to which they had attained they must secure the best men, and that meant that they must pay them fair salaries. They did not wish to pay men more than fair salaries, but they could not expect to get men on better terms than others, and they must also remember that the General Post Office and some of the other cable companies not only gave their employés good salaries while in work, but also held out the prospect of retiring allowances after they had broken down. If they looked at the ratio of working expenses for the last few years they would see that they had not materially increased. In 1895 the ratio, inclusive of renewal fund, was about 43 per cent., whereas this year it was not quite 42 per cent., or if they excluded the renewal fund, about 35 per cent. He believed that if they compared that ratio with other companies they would find that 35 per cent. was very moderate indeed. During the year they had carried on their cables no less than 9¾ millions of words, which had been exceeded in only two previous years. In 1899 the total was 10¾ millions, but then they had the whole of the German traffic. It showed, therefore, that they were still carrying the bulk of the business that they had already carried, in fact, they had at present lost very little. The renewal fund had increased by £49,535, making it £897,602, but the actual market value was only £880,000. That was by no means too much. If the company had to lay a new cable now there was no doubt that they would have to pay considerably more for it than when they laid a cable in 1894. Gutta-percha alone was more than doubled in value since that time, and therefore if the renewal fund was sufficient a few years ago to replace 1½ cables or more, the amount that they had got now would not bear such a ratio to the expenses of a new cable as it then bore. If they would look at the renewal fund of their partners, the Direct Cable Company, they would find that with one cable only they had a renewal fund of half the amount (£450,000), therefore this company was quite out of proportion to them as regards the renewal fund. The chairman then referred to the Marconi system which had attracted so much attention in the newspapers, and in the scientific and telegraphic world. It was not for him to pronounce upon the merits of that system. The directors were not experts, but no one could say what might happen in these days of scientific discovery. The Marconi or any other system that was invented would have very considerable difficulty in beating the working of the Anglo-American Telegraph Company. They were able to send to New York and receive a brief message in reply in less than one minute. That was a very difficult thing to beat, and they must look upon the Marconi system as a competitor on fair and level grounds. Unless that system was able to telegraph at that sort of speed, it could not compete commercially with this company. For social messages that was another matter, but after all social messages bore a very small proportion, indeed, to the amount of commercial messages which chiefly occupied their cables. That was only a matter of rapidity, but there were two other features about telegraphy which were equally important, viz., accuracy and secrecy. Unless they were able to compete with this company in point of these two at the same time, they could not compete successfully. Mr. Bevan then referred to and quoted from the speech on this subject made by Sir J. Wolfe Barry at the recent meeting of the Eastern Telegraph Company. The essence of this speech appeared in our report of the meeting. Mr. Bevan said that it was important to note that at present, with the wireless system used on board one of H.M. ships, they could not tell, to begin with, the direction from which the message was sent, and any ship which was near could possibly take off the message quite as easily as the one from which it was sent. Sir W. H. Preece's views, and also those of Dr. O. Lodge, were quoted, and the chairman added that the opinions of

eminent experts were worth more than those of directors, and he hoped that the result would be that shareholders would not be alarmed about the Anglo-American cable stock He believed that for some time to come, at least, they would continue to carry the bulk of commercial messages.

Sir GERALD FITZGERALD seconded the motion, and after a few questions had been put and answered, it was carried unanimously.

Subsequent resolutions re-elected directors and auditors, and thanked the chairman, board, and staff for their services.

City of Carlisle Electric Tramways Company.

THE report of the directors reads as follows:—"Your directors submit their report and statement of accounts for the year ended December 31st, 1901. The revenue account shows a surplus of £2,158 16s. 6d.; and the balance of profit and loss account, after providing for debenture stock interest, debenture stock trustees' remuneration, and writing off a second instalment of one-third of the preliminary expenses, is £915 16s. 2d., which your directors recommend should be dealt with as follows:—

To carry to the fund to meet depreciation	£570 17 6
To carry forward..	344 18 8
	£915 16 2

The car-miles run in the period have been 323,044, and the number of passengers carried 2,010,873. The sum of £500 carried to reserve, in respect of the period to December 31st, 1900, has been employed, with other funds, in the purchase of three new cars which were urgently required, and it is intended to devote the further sum of £500, proposed to be set aside this year, to the same purpose. In arriving at the amount recommended to be carried to the reserve fund, depreciation on the new cars is specially provided for. Your directors regret to report the resignation, as a director, of Mr. G. Richardson, in whose place Mr. R. Creighton, of Carlisle, has been appointed. The directors who retire are Mr. G. Readman and Mr. R. Creighton, who, being eligible, offer themselves for re-election. Messrs. Walter J. Kershaw & Co., the auditors, also retire, and are eligible for re-election."

Mileage	323,044
	Per car-mile.
Number of passengers, 2,010,873	6·22d.
Traffic receipts	6·23d.
Total receipts	6·46d.
Total expenses (71·71 per cent. of receipts)	4·63d.

Northampton Electric Light and Power Company.

THE annual report to be presented at the annual meeting of the shareholders on February 15th reads as follows:—

Since the presentation of the last annual report, the steps then being taken with a view to more economical working and greater efficiency have been diligently followed up, and important improvements in management and administration have been brought about. The saving in fuel, oil, &c., has been most marked, and in all respects the company is now working under new conditions. The year opened very badly, in spite of which the new result is of a gratifying character. The second half of the year shows a profit, after ample provision for all contingencies, which would have admitted of a very substantial dividend on the ordinary shares. The change-over to the higher voltage was successfully effected in April last. The boilers and accessories suffered much in the past from the hardness of the water, but an effectual remedy has been found in a softening apparatus, supplied by Messrs. Mather & Platt, at a moderate expense. The lamps fixed have increased by 2,962 and motors (reckoned in their equivalent of lamps) by 700 making 29,121 in all (at 8 C.P.). The growing use of current for motive power is very satisfactory, being conducive to a larger day load, always a great desideratum. From the beginning of the new year the price of current for motors and heating purposes is reduced to a uniform rate of 2d., whereby the advantages of electricity are made available for all classes of the community using machinery or requiring electric stoves. The meter rents have also been considerably reduced. The consumers now number 502. The directors have abstained from any large extension of mains during the year, the additions amounting to 436 yds., making a total of 7 miles and 1,026 yds. Inquiry has been made by the Corporation of Northampton whether the directors would be willing to enter into negotiations for the sale of the company's undertaking. Any further steps will be notified to the shareholders in due course. After setting apart £800 for depreciation, and £43 in reduction of preliminary expenses, there remains applicable to dividends a sum of £1,526 11s. 10d. It is proposed to pay a year's dividend on the 6 per cent. preference shares, £226 10s.; on the 5 per cent. preference shares, £466 1s.; also 3¼ per cent. on the ordinary shares, £798 3s. 7d.; and to carry forward £35 17s. 3d. Mr. R. Cleaver and Mr. H. Manfield retire from the board in rotation, and will be proposed for re-election.

We have received a prospectus of an issue of 5 per cent. preference shares and ordinary shares and 4 per cent. first mortgage debentures. 4,668 "B" shares are being offered, and a number of £50 debentures will be issued from time to time at a premium of 2 per cent. Prospectuses and forms of tender can be obtained on application at the company's offices, 2, St. Giles's Square, Northampton, but existing shareholders will be considered to have the first claim. Applications should be lodged by February 15th.

Smithfield Markets Electric Supply Company.

THE directors' report to be presented at the meeting to be held to-day at Winchester House reads as follows:—"The directors beg to submit herewith their report and statement of accounts for the year ended 1901. The revenue account shows an increase in the receipts of £3,058 13s., exclusive of the amount received from the cold air store, which has been transferred to net revenue account, and a gross profit on working of £4,307 5s. 11d. as compared with £2,952 9s. 3d. in 1900. The net profit for the year, after providing for interest, depreciation, and other charges is £1,824 14s. 10d., an increase of £939 11s. 1d. To this must be added the amount brought from last year's accounts £675 1s. 1d., making a total credit balance of £2,499 15s. 11d. Of this balance, however, a considerable part has been appropriated for the extension of the business, as no working capital was available, and the directors regret, therefore, that they are not in a position to recommend the payment of a dividend for the past year. There has been a substantial increase in the number of new installations and lamps connected, while the cost of production has been still further reduced as the result of the increased output and the improvements which have been introduced in the generating station. The following table shows the progress of the business during the past four years:—

Year.	No. of consumers.	Lamps.	Gross revenue.	Gross Profit.
			£	£
1898	188	9,723	6,501	384
1899	266	16,960	12,083	1,560
1900	323	23,289	15,187	2,952
1901	351	25,870	18,251	4,307

The plant and machinery have worked satisfactorily throughout the year and are in good condition. The director retiring by rotation is Mr. H. S. Leon, who, being eligible, offers himself for re-election. The auditors, Messrs. Ford, Rhodes & Ford, also retire and offer themselves for re-election."

Waterloo and City Railway.

THE half-yearly meeting of the shareholders of this company was held on Thursday last week at Waterloo Station, Sir Wyndham Portal, Bart., in the chair.

In proposing the adoption of the report, the CHAIRMAN said the story he had to tell was a very simple one; but he hoped a gratifying one. On this occasion the company was able to pay a dividend of 3 per cent. per annum without being in any way indebted to the working company—the London and South-Western Railway. That was the first time the company had been in that happy position, and he thought the fact deserved attention. It was true the sum to their credit was only a small one, £121, but still it showed that they had turned the corner, and it augured well for the future. Referring to the accounts, it would be seen that the total sum spent on capital up to the present time was £599,000, and they hoped to close that account altogether during the present half-year. The revenue account showed that the receipts from passenger fares had amounted to £16,785 as against £15,616 in the corresponding period of 1900. The total revenue was £16,686 as against £15,489, or an increase of nearly £1,200. On the debtor side, the working expenses had amounted to £7,588 as compared with £8,322, which gave them a surplus of £103 instead of a deficiency of £1,732; and the balance to net revenue was £8,739 as against £8,639. He had had some correspondence with one or two gentlemen in reference to the "contingent liability" mentioned in the auditor's certificate. That was nothing new, and had been in each certificate (except the first) since the opening of the line. It referred to the deficiency in net revenue which had to be made up by the working company in any half-year where such net revenue was not sufficient to pay 3 per cent. on the ordinary and borrowed capital. With the exception of the half-year now under review, there had unfortunately been a deficiency in each half-year since the line was opened, and on June 30th, 1901, the total deficiency amounted to £12,011 8s. 7d. The same agreement which provided for that deficiency being made up by the working company also provided that they should be entitled to recoup themselves out of any excess over 3 per cent., and they were, therefore, entitled to retain the £103 excess. The total deficiency, therefore, at the present moment stood at £11,907 9s. 2d., and under the agreement that had to be disposed of before any excess over 3 per cent. could be divided, as therein provided, between the owning and the working companies. The working expenses, he was glad to say, continued to decline. For the half-year ending June, 1899, they were 66·83 per cent.; December, 1899, 55 per cent.; June, 1900, they remained the same; December, 1900, they had fallen to 53·75; June, 1901, 54·78; while this last half-year they had fallen to 45·50 per cent. They hoped to go on in that direction and gradually get the working expenses down.

The Hon. H. W. CAMPBELL seconded the motion.

Replying to a question, the CHAIRMAN said he did not know whether it might be possible to make some arrangement with the London and South-Western Railway in respect to the amount due to them by the City and Waterloo. As shareholders they would only be too delighted if that company could see its way to make them some concession on the point.

The report was then adopted.

National Telephone Company, Limited. — The directors have resolved to recommend, at the forthcoming general meeting of shareholders, the following dividends for the half-year ending December 31st last:—At the rate of 6 per cent. per annum on the first and second preference shares; at the rate of 5 per cent. per annum on the third preference shares; at the rate of 6 per cent. per annum on the preferred stock, and at the rate of 4½ per cent. per annum on the deferred stock, being equivalent to 5 per cent. per annum on the ordinary shares, now divided into preferred and deferred stocks; less income-tax in all cases; carrying £100,000 to reserve and about £7,000 forward, The transfer books will be closed from the 14th to the 27th inst., both days inclusive, and the dividend warrants will be posted on the latter date.

Charing Cross and Strand Electricity Supply Corporation.—The directors have decided to recommend a dividend for the half-year ending December 31st, 1901, at the rate of 12 per cent. per annum, making, with the interim dividend already distributed, 10 per cent. for the year (as against 9 per cent. last year), and carrying forward £10,650, as against £3,485 last year. The equivalent of 75,957 8-c.p. lamps have been added during the year.

Stock Exchange Notices.—The Committee has appointed a special settling day as under:—Wednesday, February 19th, Armstrong (Sir W. G.) Whitworth & Co., Limited—£750,000 4 per cent. first mortgage debentures of £100 each, Nos. 7,501 to 15,000 (registered). The Committee has also ordered the same, and Folkestone Electricity Supply Company—£50,000 4½ per cent. first debenture stock to be quoted in the Official List.

Telegraph Construction and Maintenance Company.—The directors propose paying a dividend of 10 per cent. (£1 4s. per share), together with a bonus of 5 per cent. (12s. per share), in addition to the 5 per cent. already paid, making 20 per cent. for 1901.

City of London Electric Lighting Company.—The directors announce the following dividends, after provision for reserve:—Preference shares, a final dividend of 6s. per share for the six months ended December 31st, making a total of 6 per cent. per annum; ordinary shares, 10s. per share, being at the rate of 5 per cent. for the year ended December 31st last, carrying forward a balance of about £13,000.

New Issue.—It is announced in the *Investor's Guardian* that the Dudley, Stourbridge and District Electric Traction Company is about to offer £60,000 4½ per cent. debenture stock at par.

Brompton and Kensington Electricity Supply Co.—The share transfer books of this company will be closed from February 22nd to the 28th.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Feb. 17th were £591; corresponding week last year, £396; increase, £195. Total to date, £3,357; corresponding period last year, £2,855; increase £502. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending February 8th were £153; corresponding week last year, £139; increase, £14. Total receipts to date, £883; corresponding period last year, £814; increase, £69.

Bristol Tramways and Carriage Company.—The receipts for the week ending February 7th were £3,587; corresponding period last year £3,320; increase, £267.

Central London Railway.—The receipts for the week ending Feb. 8th were £6,534; corresponding week last year, £6,129; increase, £405. Total receipts to date, £39,413; corresponding period last year, £36,707; increase, £2,706. Miles open, 6.

City and South London Railway.—The receipts for the week ending Feb. 9th were £3,091; corresponding week last year, £2,027; increase, £1,064. Total receipts to date (6 weeks), £18,168; corresponding period last year, £12,037; increase, £6,131. Miles open, 6¾; last year, 4¾.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending January 31st:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. − £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. − £
Croydon*	656	444	—	4½	2,825	1,802	—
Devonport	353	—	—	4½	1,743	—	—
Dudley—Stourbridge	597	77	—	4½	2.643	458	—
Gateshead	597	—	—	4½	2,720	—	—
Greenock-Pt. Glasgow	299	143	—	4½	1,538	768	—
Hartlepool	155	—	13	4½	749	3	—
Kidderminster ..	84	2	—	4½	386	32	—
Merthyr	184	—	—	4½	797	—	—
Oldham—Ashton ..	418	—	16	4½	1,962	—	118
Poole	168	—	—	4½	782	—	—
Potteries	1,308	—	77	4½	5,856	—	15
Southport	116	20	—	4½	523	68	—
South Staffordshire†	665	—	4	4½	3,054	113	—
Swansea	401	17	—	4½	1,760	128	—
Taunton	45	—	—	4½	222	—	—
Tynemouth	164	—	—	4½	807	—	—
Wolverhampton Dist.	121	71	—	4½	492	297	—

* Partly horse. † Partly steam.

Dover Corporation Tramways.—The receipts for the week ending February 8th were £161 6s. 8½d.; corresponding week last year, £152 2s. 3d.; increase, £9 4s. 5½d. Total to date, £974 7s. 10d.; corresponding period last year, £927 4s. 2d.; increase, £47 3s. 8d. Miles of track open, 8. Car miles run, 1902, 5,062; 1901, 4,969. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending February 7th were as follows:—D.U.T. Co., £3,269 0s. 8d.; D.S.D. Co., £653 8s. 7d.; total, £3,922 9s. 3d.; corresponding week last year—D.U.T. Co., £2,963 12s. 9d.; D.S.D. Co., £631 19s.; total, £3,595 11s. 9d.; increase, £326 17s. 6d.; aggregate to date, £22,059 5s. 4d.; last year, £20,918 17s. 11d.; increase, £1,140 7s. 5d. Mileage worked 46.

Glasgow Corporation Tramways.—Receipts for week ending February 1st, £9,889 5s. 3d.; corresponding week last year, £7,928 3s. 10d.; aggregate to date, £423,500; corresponding period last year £328,056.

Liverpool Overhead Railway.—The receipts for the week ending February 9th were £1,245; corresponding week last year, £1,515; decrease, £270. Total to date £8,112; corresponding period last year, £8,913; decrease, £801. Miles open, 6 miles 67 chains; last year, 2 miles 40 chains.

Sunderland Corporation Tramways.—The receipts last month totalled £4,478.

STOCKS AND SHARES.

Wednesday Evening.

There is a slight falling off in business to chronicle, so far as the markets with which we deal are concerned. The slackening must, of course, be ascribed to the enormous amount of trade passing in the South African department, where the speculative wave grows in volume every day. So great have been the numbers of Kaffir purchases, that buyers found it in many cases very difficult to find financial accommodation early in the week, and consequently a fair number of investment securities had to be realised to pay for speculative commitments. The effect of these sales, however, was offset by the strength of Consols and kindred stocks, while in the Electricity Supply section the dividends which have appeared are all refreshingly good. There is not much doing in telegraph descriptions, but the tone is firm. Electrical railways are very little altered. The feature of the miscellaneous list is a sharp advance in Telegraph Construction shares.

Central London stocks are practically unmoved at the appearance of the report of the Board of Trade Committee on vibration. It is not thought in the Stock Exchange that any heavy new capital outlay will be required, and, therefore, the report can be disregarded, say the insiders. But the prices are somewhat inclined to hang, and this notwithstanding the philanthropic tip of a "large shareholder." City and South London is steady, and we hear of a buyer for the company's Third Preference, on the basis of 116 to 118, *ex* the 2½ per cent. dividend. Since the stock will pay a purchaser just over 4 per cent on his money it is fairly cheap, but we should like to know how much of it the company has unissued before recommending it as strongly for investment as we might otherwise do. Waterloo and City Ordinary is somewhat scarce, and the bareness of stock has forced the price up a point, although a buyer would probably find some difficulty in obtaining a decent amount of stock even at the top quotation. Great Northern and City Preferred "A" are 8½, unaffected by the meeting or by the Great Northern Company's report.

The unwise quarrel between the two Underground Railways is stopping all rise in the stocks of either company, Metropolitan Consolidated being 78 and District Ordinary 28¼. The District Company manages to squeeze out a lordly 15s. per cent. as dividend on its 4 per cent. Guaranteed (1908) stock, the 5 per cent. Preference, of course, receiving nothing. The price of this last-named stock is about 60, and District 4 per cent. Debenture only command par, the 6 per cent. Perpetual Debenture being more than 50 points higher. Metropolitan 4 per cent. Debenture, it is worth noticing, stands at 123¾ and business was done at this price on Tuesday.

In the electrical supply division, seven rises go against two falls, the latter being in Smithfield Market and Chelsea Ordinary shares. Bromptons show no change upon the excellent dividend, notice of which was being sent out even as we wrote last week forecasting a better distribution. Charing Cross and Strand, both Ordinary and Preference, are better upon the capital 12 per cent. dividend, which makes 10 per cent. on the Ordinary for the whole year. The increased number of lights is also a favourable feature in the preliminary announcement of the Charing Cross Company. Blackheath 4½ per cent. Debenture has been run up three points, but the Ordinary shares do not move from the vicinity of half a sovereign. City of London 5 per cent. Debenture has also strengthened, and Chelsea Debenture, notwithstanding the decline in the price of the shares, is up a point. City shares are 10s. to the good upon those dividend estimates to which we referred last week. Metropolitan Debenture has just exceeded par in its buying quotation, and we have so frequently noted the scarcity of gilt-edged supply stocks that these advances in Debentures call for no further comment.

Telegraph dealers are not wholly sure whether the time is approaching for another little Marconi shake out in their market. It is to be hoped that telegraph holders will not lose their heads or the rest of their shares so quickly as they did a month ago. At the Anglo-American Telegraph meeting the other day the chairman made his hearers laugh by telling them that Mr. Marconi was making extensive use of their system! Marconi shares are rather dull at 2¾ to 3, despite the glowing, patronising report just issued by the company. Commercial Cable Debenture stock has hardened 2 per cent., and Direct United States shares are a little better, otherwise the telegraph list is featureless. Globe Telegraph and Trust Preference have recovered ¼ to 14, and are well worth another £1.

National Telephone shares have now dropped from the list, and the market quotes Preferred and Deferred stock instead. The making up prices of these last Tuesday were 100 and 62 respectively. British Insulated Wire shares are again flat, but Telegraph Constructions have spurted £2 upon the declaration of the dividend, which is better than had been expected.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Feb. 5th.	Closing Quotation Feb. 12th.	Business done during week ended Feb. 12th. 1902. Highest.	Lowest
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	51 — 53	51 — 53	52½	...
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	95½— 96½	95½— 96½	96¾	95¾
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.%	2s.	8½— 8¾	8 — 8½	8⅝	8⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —170	165 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	93 — 96	96 — 99	98	95
16,000	Cuba Telegraph	10	7 %	...	...	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102	98 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	10 — 10½	10¼— 10¾	10½	10¼
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	134 —139	134 —139	139	135
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	90 — 92	90 — 92	92	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	109 —113	109 —113	112½	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	13½— 14	13½— 14	13 15/16	13½
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	109 —114	109 —114	109½	..
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	100 —103	99 —102	100½	99⅜
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103 %	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	9½— 10 xd	9½— 10	10	9⅞
180,042	Do. do. 6 % Pref.	10	...	...	...	13½— 14 xd	13¾— 14¼	14	...
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	28 — 30	28 — 30	29½	29
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	93 —103	99 —103	101	100½
17,000	Indo-European Telegraph	25	10 %	10 %	...	38 — 42	38 — 42	40	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ⅜	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	5 %	5 %	5 %	3⅜— 3⅞	3⅜— 3⅞	3 11/16	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13⅜	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜— 5	4⅜— 5	4 15/16	4⅞
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 96	93 — 96	94⅛	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	101 —105	101 —105	103½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	...	⅝— 1	⅝—1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	118 —124	119 —125	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4¾— 5¼	4¾— 5¼	4 15/16	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	102	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13 — 13½	13 — 13½	13⅜	13⅛
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103	100 —103	...	...
88,321	West India and Panama Telegraph	10	5%	...	...	⅝— ¾	⅝— ¾	⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5½— 6	5½— 6	5⅝	5 9/16
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½— 4½	3½— 4½	...	...
80,000£	Do do do 5 % Debs., Nos. 1 to 1,800	100	...	...	...	100 —103	100 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅝— ⅝	⅝— ⅝	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	97 — 102	100 —105	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	...	9¼— 9⅜	9¼— 9⅜	9 7/16	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9 — 9½	9 — 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	8 — 9	8½— 9½	8⅝	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5½	5¼— 5⅜	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	103 —105	103 —105	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	...	5½— 6	5 — 5½	...	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	108 —111	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	...	9 — 10	9½— 10½	9⅛	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	12⅜	12⅝
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	121 —126	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104	101 —104	101	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	...	8½— 9½	8½— 9½	9⅛	9⅛
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	12⅝	12 1/16
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	..	106 —109	106 —109	108¼	108
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	5¾— 6¼	5¾— 6¼	...	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5¾— 6¼	5¾— 6¼	6⅛	6 1/16
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	105 —108	105 —108	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104 xd	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	...	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	...	15½— 16½	15½— 16½	15⅝	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	93 —101	100	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	..	15 — 16	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½— 16½	15½— 16½	..	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	9	8 15/16
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	99½	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	1⅞— 2¼	2 1/16	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90 xd	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	...	12 — 13	12 — 13	12⅞	12⅜

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Feb. 5th.	Closing Quotation Feb. 12th.	Business done week ended Feb. 12th, 1902. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	87 — 91	88 — 92	...	...
62,074	British Electric Traction	10	8 %	9 %	...	14 — 15	14 — 15	14⅜	14¼
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 13	12½ — 13	12⅞	12¾
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	129	128½
70,000	British Insulated Wire Ord.	5	20 %	15 %	...	9½ — 10½	8½ — 9½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅜ — 6¼	5⅜ — 6¼	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	⅞ — 1	⅞ — 1	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	1 5/16 — 1 1/16	20s. to 21s.	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½ %	5 %	...	1⅜ — 1⅝	1⅜ — 1⅝	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	...	...	...	99 —102	97 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	16½ — 17½	16½ — 17½	17¼	16⅝
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	5⅝	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	112	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	106 —109	106 —109	107½	106½
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	106 —109	106 —109	107¾	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	106 —109	106 —109	...	...
855,000	City and South London Railway	Stock	1⅞ %	1½ %	2 %	65 — 68	65 — 63	68	66½
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000	10	...	...	...	6 — 6½	6¼ — 6⅜	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½ %	8 %	...	3 — 3½	3 — 3½	3 5/16	3
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —104	99 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½ %	...	⅜ — ⅝	⅜ — ⅝	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½ %	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	78 — 83	78 — 83	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	83 — 88	83 — 88	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅝ — 2¼xd	1½ — 2	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	98½	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9¾ — 10½	9¾ — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	99 —102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	...	17 — 18	17 — 18	18	17¼
35,000	Do. do. do. 4½ % Pref.	5	4½ %	4½ %	...	5½ — 6	5½ — 6	5⅝	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	...	...	21 — 22	21 — 22	21¾	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3⅜ %	3½ %	1½ %	5⅛ — 5⅜	5⅛ — 5⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	11½ — 11¾	11½ — 11¾	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½ —16½	15½ — 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	20 %	35 — 38	37 — 40	39⅜	36½
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —104	102 —104	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	92 — 95	92⅞	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance 2/—4/-
National Electric Free Wiring, 17/6 paid, ½—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅛—10⅜.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, February 12th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£18	£18	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£20 10	£20 10	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£81	£81	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£85	£85	..
a Shellac	per cwt.	125/-	125/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£3	£3	..
a Bichromate, casks ..	per lb	2¼d.	2¼d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 3" to 12") basis	per lb.	6½d.	6½d.	½d. inc.
c Tube (brazed)	per lb.	8d.	7½d.	½d. inc.
c „ „ (solid drawn) ..	per lb.	6½d.	6½d.	½d. inc.
c „ Wire, basis	per lb.	7d.	6½d.	½d. inc.
c Copper Tubes (brazed) ..	per lb.	8½d.	8½d.	½d. inc.
c „ „ (solid drawn) ..	per lb.	8½d.	8¼d.	½d. inc.
g Copper Bars (best selected) ..	per ton	£71	£71	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£71	£71	..
g „ Rod	per ton	£71	£71	..
e „ Electrolytic) Bars ..	per ton	£60	£63	£3 dec.
e „ „ Sheets ..	per ton	£75	£75	..
e „ „ Rod ..	per ton	£66	£68	£2 dec.
e „ „ H.C. Wire	per lb.	8¼d.	8¼d.	..
f Ebonite Rod	per lb.	9/-	9/-	..
f „ Sheet	per lb.	5/-	5/-	..
h German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine ..	per lb.	3/3	3/3	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	45/7½	44/9	10½d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 5	£9 10	5s. dec.
g Lead, English Ingot	per ton	£11 15 to £11 17 6	£11 15 to £12	dec.
g „ „ Sheet	per ton	..	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	8/8 to 7/8	8/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p „ „ strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£115 to £116	£112 10 to £113 10	£2 10 inc.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/6	1/5	1d. inc.
p White Anti-friction Metals —				
"White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 ten. Flax	per lb.	5½d.	5½d.	..
j „ 3 ply 10 lbs. Russian ..	per lb.	6 3/4d.	6 3/4d.	..
j „ 18 lbs. Russian, single ..	per lb.	4½d.	4½d.	..
j „ 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh's. (Vielle Montagne bnd.)	per ton	£22	£22	..

Quotations supplied by { a Messrs. G. Boor & Co. / b The British Aluminium Co., Ltd / c Messrs. Thos. Bolton & Sons. / d Messrs. F. Wiggins & Sons. / e Messrs. Frederick Smith & Co. }

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works / g Messrs. James & Shakspeare. [Co., Ltd. / h Messrs. Edward Till & Co. / i Messrs. Bolling & Lowe. / j Messrs. Walter B. Hindley & Co. }

Quotations supplied by { k Messrs. Morris Ashby, Limited. / m Messrs. W. T. Glover & Co., Ltd. / n Messrs. P. Ormiston & Sons. / o Messrs. Johnson, Matthey & Co., Ltd / p The Phosphor Bronze Company, Ltd. }

INSTITUTION OF ELECTRICAL ENGINEERS.

EARTH CURRENTS DERIVED FROM DISTRIBUTING SYSTEMS.

By E. Basil Wedmore, Associate Member.

(Abstract of Paper read January 23rd, 1902.)

(*Concluded from page* 238.)

The direction of the current lines would not be very different were the earth a solid conductor. In fig. 3 are shown the current streams for a sheet, the current entering at B, and leaving at A. Fig. 4 illustrates an approximation to the current distribution that would obtain in a hypothetical case, in which all the current is fed into one end of the rail, and taken out at the other, the leakage being distributed as in a Fourier bar. Fig. 5 gives the surface distribution of current streams on the assumption of a homogeneous earth, the current being fed in at B and taken out at A. The simple graphical construction for obtaining these curves is the same as would be used for a magnetic flux.

In the light of the above we are amply justified in concluding that we know the distribution of magnetic force in the neighbourhood of a traction system, and that we know the direction of the current streams near the surface of the earth, but further information is required before we can calculate their strength, for if the current flows in a plane of relatively small thickness the current density at any point will be *inversely as the distance* between the lines of current (see fig. 4), while if the current flow through the body of the earth the current density at any point will be *inversely as the square of the distance* between the current lines at that point.

At Stockton we have seen that the horizontal component of the magnetic disturbance at a point 0·8 miles from the line was 15×10^{-6} absolute units. If the earth is a solid conductor, the fall of potential along the current stream must have been at the rate of about 1 volt per 60,000 yards.

We may apply the value of the earth's specific resistance to the estimation of the current that would flow into a pipe of a given diameter, given the potential difference between the pipe and the body of the earth.

Let r_1 = radius of the external circumference of the pipe, in inches.

r_2 = a larger radius measured from the axis of the pipe into the earth, in inches.

K = specific resistance of the earth = 2,700 ohms per inch cube,

then R the apparent resistance of the earth over a square inch of pipe surface is given by the following:—

$$R = 2{\cdot}303\ K\ r_1\ (\log r_2 - \log r_1),$$

from which we may calculate the current density for a given voltage.

If we allow, taking into account the spreading of the current as it leaves the pipe in a direction parallel to the axis of the pipe, that the whole resistance will be practically equal to that reached at a radius of 1,000 in. without spreading, then inserting 2,700 for K, we have:—

$$R = 6{,}000\ r_1\ (3 - \log r_1).$$

For a 10-in. pipe we have R = 69,000, while for a 2-in. pipe R = 18,000 ohms, that is to say, the smaller the pipe the less the resistance over a square inch of surface. This is perhaps an unexpected result.

In estimating the value of K it was found that one-fifth of the resistance to the earth currents is encountered in the first 10 ft. of ground, and about half in the first 100 ft. The value obtained, therefore, is not materially affected by any considerations as to whether the currents penetrate below a depth of a few hundred feet or so.

It might be thought that the presence of pipes in the surface layers of the earth would so materially improve the conductivity near the surface that return currents would be almost confined to that region. Were this the case, however, the conductivity would

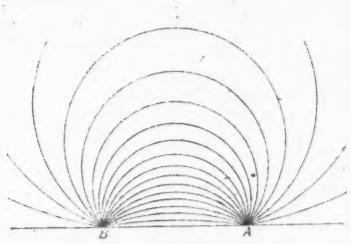


Fig. 3.

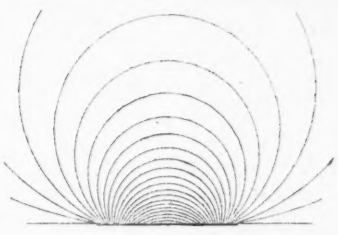


Fig. 4.

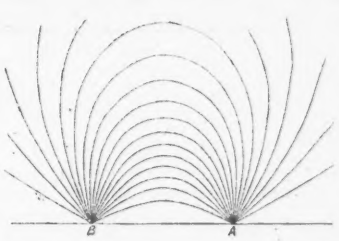


Fig. 5.

If the current sheet be 250 ft. deep, the voltage drop must have been about 1 volt per 1,000 yards. At greater distances from the line, the difference between the two results will be largely increased. In calculating these values, the specific resistance of the earth has had to be considered.

When the bonded rails for the track of the London United Tramways Company were laid, it was found by experiments on some 2½ miles of track that there was a variation of potential occurring along the rail such as would correspond to a flow of + or − 15 amperes along the rails. The current alternated in direction. The voltage drop before the rails were introduced must have been still higher. The voltage drop was about 0·2 volt per mile, which, considering the distance of the nearest traction system, points to a current sheet.

Fall of potential tests made at divers places by divers persons give values at least as high as the figure given for a 250-ft. current sheet, which makes it probable that often, if not always, the currents return in a sheet of comparatively small depth.

Mr. Evan Parry has shown that there is an apparent resistance between the rail and the earth of about 740,000 ohms over a square inch. This is equivalent to about 5,000 ohms over a square foot, so that if the rail was at a potential of 5 volts above that of the earth, the maximum current density would be less than one-thousandth of an ampere per square foot, and this would rapidly decrease as the distance from the rail increases. Consider the path of any portion of the current flux. The current enters the earth, spreads out into a larger and larger stream, converges on a distant part of the rail, and enters the same again. On its path it meets with certain resistance offered by its earth path, possibly certain resistance offered at the contacts between rail and earth, and possibly with certain electrolytic E.M.F's. If we assume that the whole of the resistance is that offered by the earth, and with that as basis calculate the specific resistance of the earth, we shall be over-estimating rather than under-estimating the value of the same.

On several occasions since March, 1900, I have approached this question, having estimated as accurately as possible the dimensions throughout of one or more current paths through the earth, based on measurements made in England and Ireland, and again on Mr. Parry's published data. Given the dimensions, the calculation of the specific resistance is easy. The values obtained have always been in the neighbourhood of 75 ohms per yard cube. We may compare this with the values of 50 ohms per yard cube for clay containing about 60 per cent. of moisture and 35 ohms for sand containing about 8½ per cent., given by Herrick.

be largely dependent on the state of the weather. So far as I can discover, all experiments on a large scale have shown the contrary to be the case. I have attempted to discover traces of electrolytic E.M.F's. by a careful comparison of the theoretical curves given by Mr. Parry with curves obtained in practice, but have been unable to obtain any positive evidence. In general, the agreement and general reliability of the curves in cases where the E.M.F. is both below and above that necessary to decompose water would seem to be additional evidence that the conductivity of the earth did not depend much on electrolytic actions. Experiments made by Mr. George Claude, and communicated to the Société des Electriciens in July, 1900, showed that if a current was passed between lead plates buried in the earth, with a potential difference of 23 volts, the amount of decomposition produced was as though only 40 per cent. of the current had been flowing, and this figure was reduced to 4 per cent. if the voltage was reduced to 1 volt. Herrick has given a figure corresponding to the latter for iron plates.

Recent observations tend to show that in the past electrolytic troubles have been very much overrated, and that in many cases corrosion, not due to earth return currents, but to the usual taxes levied by Nature upon the users of inferior metal, has been attributed to the return current. Cast-iron has been found more free from corrosion than wrought-iron, and oxides produced at the seat of electrolysis increase the resistance, and reduce the electrolytic current.

It is quite a different matter when one comes to consider the effects due to leakage in connection with the earthed middle wire of a three-wire lighting system. In this connection the formulæ developed above for the current density in the surface of small pipes will be found of interest.

The notion that there is a practically constant resistance between tram rails and the body of the earth, now well proven, serves to simplify the consideration of many problems depending on the nature of the earth return. As an example a brief consideration will be given to the question of bonding water-pipes to the rail in the neighbourhood of the traction station—a question on which some difference of opinion has recently arisen in at least one quarter.

The primary object is to reduce both the *area* of pipe *out* of which current is flowing, and to reduce the *density* of the outward flowing current. If there is no connection between the pipes and the rail, the current flowing into the surface of the pipes must equal the current flowing out of the surface of the pipes, and when either is a minimum, both will be a minimum. The rail being dis-

connected from the pipes, its potential will be such that the sum of the resistances to the inward and outward flowing currents will be a minimum. A point about the middle of the rail will be at zero potential, the further end + and the station end —. The earth current will also be a minimum. If now the + or further end of the rail be connected to the pipes, the area over which the current leaves the pipes will be considerably augmented, but the area of rail — to the earth will also be considerably augmented, thus increasing the total leakage current. If, however, the — end of the rail be connected to the pipes, the rail, as a whole, will be positive to the earth, and the pipes, as a whole, will be negative to the earth, the amount of current leaving the pipe surfaces being a minimum. The pipes may now be considered as an extension of the rail, and the best protection will be obtained when the point of junction is at the earth's potential, other things being equal. The currents entering and leaving the pipes must be equal, *but no current now leaves the pipe surface.*

We have now, however, very largely increased the currents carried by the pipes. While this may be to the advantage of the current user, it may not be so to the pipe owner. At each bad joint the current will leave the pipe over a limited area at a high density and return again further on. The smaller the pipe, the higher the current density. If, moreover, the pipes are conveying electrolysable liquids internal as well as external damage may ensue.

If one had it in one's power to lay both pipes and track in the best possible manner, it would seem best where metal pipes are used to use cast-iron, to introduce resistance at every joint, to introduce any possible surface resistance, and to avoid all connections with the rails, leaving the rails to take their own potential.

In conclusion, may I express the hope that this paper will serve to at least draw attention to the lack of information on this important subject, and that in the discussion that follows, will be found the key for future investigations?

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER SECTION).

The members of the above Section met at the Physical Laboratory, Owens College, on Tuesday evening, January 28th, under the presidency of Mr. C. H. Wordingham.

Mr. Hardman A. Earle, M.I.C.E., M.I.E.E., read a paper on "The Supply of Electricity in Bulk." Owing to the importance of the subject, and the author's connection with the Yorkshire power station, there was a large attendance. Reference has been made to the paper in our leading columns, last week and again to-day.

Mr. Earle referred in detail to the principal works in America, Canada, Germany, Italy, and Switzerland, where power stations had been successfully established, and pointed out the difference in the general conditions arising out of the supply of water-power to those available in this country, but contended that the first cost of large water schemes was higher per horse-power than when coal is used.

He alluded to the opposition of local authorities, prompted by their fear of competition with the supply stations they had established, and the power of speculators with a roving commission to disturb their streets, but he contended that, under the Power Bills they were fully protected.

He enumerated the works in operation, the nature of the business done, load factor and total cost, and dealt with the Board of Trade regulations, and mentioned cases in which they had consented to extra high pressure — up to 11,000 volts. Mr. Earle also gave particulars of the scheme of the Yorkshire Power Company with which he is connected, and stated that four power stations would be put down for an aggregate of 100,000 H.P., and he expected to have a load factor of 28 per cent., although he based his calculations upon 25.

The exceptional position of his company he proved by assuming that one-fifth of the current generated would be sold without conversion, owing to the large load obtainable within an area of three miles.

He calculated to obtain an efficiency of 84 per cent., and to construct his works, exclusive of mains, for £1,320,000. The mains, including cable, digging trench, cast-iron trough, &c., he estimates at £1,062 per mile, and anticipates, as the ultimate result of the trading, a dividend of 10·9 per cent. on a share capital of £2,000,000, after providing 4½ per cent. on £666,666 debentures.

The discussion upon the paper was opened by Mr. C. H. Wordingham, who presided, and was continued by Messrs. W. P. J. Fawcus, A. B. Mountain, Sturgeon, J. Shaw, J. S. Highfield, C. D. Taite, Leamington, Pooley, Tebbutt, and Dr. Paton.

The proceedings were closed by a cordial vote of thanks to Mr. Earle for his paper.

ENGINEERING EMPLOYERS' FEDERATION AND THE TRADES UNIONS, WITH NOTES ON PIECEWORK.

A new agreement between the above Federation and the three trades unions, viz., the A.S.E., the Steam Engine Makers' Society, and the United Machine Workers' Association, only awaits ratification by the men, who are to be ballotted, and will, it is expected, vote favourably.

The new agreement generally and in brief provides that employers shall not interfere with the proper functions of the trade unions, and the trade unions shall not interfere with the employers in the management of their business. Employers shall have the right to introduce any condition of labour existing prior to the date of this agreement, and the trade unions shall have the right to bring forward for discussion any question arising therefrom.

Every workman may belong to a trade union or not. Every employer may employ any man, whether he belong or not to a trade union. The trade unions will not permit, on the part of their members, any interference with non-union workmen, nor countenance any objection to working with them. The Federation will not permit of difference of treatment between union and non-union workmen in the course of their work, and will not countenance their members objecting to employ union workmen.

Employers and their workmen have the right to work piecework. The prices to be paid for piecework shall be fixed by mutual arrangement between the employer and the workman or workmen who perform the work, and the employers guarantee that they shall be such as will allow a workman of average efficiency to earn at least his time rate of wages, with increased earnings for increased production due to additional exertion on his part. The Federation will discountenance any arrangement or rearrangement of prices which will not allow a workman to obtain increased earnings in respect of increased production due to such additional exertion, and the trade unions will discountenance any restriction of output. The Federation agree to recommend that all wages and balances should be paid through the office. A mutual agreement as to piecework rates between employer and workman in no way interferes with the trade unions arranging with their own members the rates and conditions under which they shall work.

The Federation agree to recommend that no union workman should work more than 40 hours' overtime in any four weeks after full shop hours have been worked, allowance being made for time lost through sickness or absence with leave. In the following cases overtime is not to be restricted, viz.: (1) Breakdowns in plant; (2) general repairs, including ships; (3) repairs or replace work, whether for the employer or his customers; (4) trial trips. In cases of urgency and emergency restrictions shall not apply, but the Federation will recommend its members to avoid excessive overtime.

Employers shall have the right to employ workmen at rates of wages mutually satisfactory to the employer and the men concerned. The trade union shall have the right to arrange with their members the rates at which they will accept work, but shall not interfere with the wages of other workmen. General alterations in the rates of wages shall be negotiated between the respective employers' associations and the local representatives of the trade unions.

There shall be no limitation of the number of apprentices.

Employers shall appoint the men they consider suitable to work machine tools, and determine the conditions under which they shall be worked, and shall select, train, and employ those whom they consider best adapted to the various operations carried on in their workshops, and will pay them according to their ability as workmen.

The Federation recommend their members that when they are carrying out changes in their workshops which will result in displacement of labour, consideration should be given to the case of the workmen who may be displaced, with a view if possible of retaining their services on the work affected or finding other employment for them.

With a view to avoid disputes, deputations of workmen shall be received by their employers, by appointment, for mutual discussion of questions in the settlement of which both parties are directly concerned. In case of disagreement, it shall be competent for either party to refer the question to a conference to be held between the local association of employers and the local representatives of the trade unions. Failing settlement at a local conference, it shall be competent for either party to refer the matter to the executive board of the Federation and the central authority of the trade union or trade unions concerned. Until the question has been discussed in local and central conference there shall be no stoppage of work either of a partial or of a general character, but work shall proceed under the current conditions.

There may not perhaps appear much in the foregoing abstract of the agreement. Perhaps its chief value lies in the fact that there is a practical acknowledgment that restriction of output has been practised. The part relating to overtime will appear strange to many employers, whose great difficulty has often been to prevent overtime being worked, and we make bold to say that were restriction not practised there would be far less need anywhere to work overtime. As regards piecework, there can be very little doubt that when properly arranged piecework is a fair system, but we are bound to say that one of the chief reasons why it has been a cause of so much trouble is the bad faith of employers, who seem unable to bear the sight of a man earning, as they term it, "too much." Want of ability in estimating piece rates and want of honour to stick to their own ratings has been responsible for much of the trouble with piecework.

When by ingenuity a workman has cut down his time on any particular job it is only natural that he should expect to be paid at the fixed rate. Should he earn "too much," many employers never rest until the rate has been cut. Thus men learn to nurse their jobs, and only earn what they know will be permitted them. In this way both employers and employed lose the benefit of piecework, for men will not exert themselves to reduce the time on jobs when they find themselves deprived of all share in the results Hence arise the numerous attempts to create systems of premiums

that will avoid the direct piece system. We have seen none that appear to get well over the difficulty, because they are all based on some direct arithmetical ratio of division of the benefit, and the workman still gets "too much" in the eyes of the employer. It seems to us that if the premium on work were made to follow a formula depending on some root value of the work done it would be easier to adhere to. Suppose, for example, that when a rate has been fixed on the basis of an output of N pieces per unit of time, it must have been a very bad estimate of the value of N, which even doubled this, and made the output 2 N. The man who did 2 N pieces on a rule based on $\sqrt{N}$ would only earn an excess of 40 per cent. over wages. He would do four times N pieces to earn double wages. Yet if by dint of attention he did 1·5 N pieces, he would earn an additional 22 per cent. If he fell below N from any cause, say, even to 10 per cent., he would only suffer about 5 per cent. loss of money. A piecework rule based on $\sqrt{N}$ would give a fair and considerable advantage to the man who could increase the output by one-half. Yet, in the event of a serious error having been made in the rating, it would be very difficult for a man to earn a very serious excess. Such a rule would, in fact, always give the workman a good premium for ordinary industry, while preventing those high excesses due to errors in price fixing, which do as much harm to the men as to the employers.

A piece rate to be effective must offer such inducements to the men to exert themselves, that they will expend reasonable energy. It should not tempt men to excessive exertion, because such excessive exertion for the benefit of one employer tends to throw on the community a worn-out cripple at an early age to be a permanent burden on it. If by doubling his output a man, earning 40s., can now earn 56s., he will probably do so. But a treble output will only yield about 69s., and even if possible, men will not be tempted to try it. The man is protected thereby against the errors of the rate-fixing department, and so also is the department itself. We do not say that the basis of a rate fixing should be $2\sqrt{N}$, but that such a basis would give better results than any system we have yet examined. Accepting the principle, it would be easy to fix a formula to give results incomparably superior to those obtained in general, and such as would destroy most of the serious objections to piece rates as existing.

[Since the above article was written we find that the result of the voting upon the new agreement is as follows: For acceptance, 7,379; against, 14,879. Mr. Barnes says that the result will be made the subject of further discussion.]

CURRENT SPECIFICATIONS.

XCI.—CROYDON TRAMCARS.

Summary.

Extent of Contract.—Supply and delivery of 10 car bodies, trucks and equipments to comply with specification.

Type of Car.—To be double deck, generally of design shown on drawing issued with specification, capable of seating 30 passengers inside and 38 passengers outside. Cars to be mounted on maximum traction trucks.

Gauge of Line.—4 ft. 8½ in.

Life Guards.—A sum of £12 per car to be reserved for this item to be expended as directed by the engineer.

Trucks.—To be either of Peckham or Brill standard maximum traction type, roller bearings being fitted to all journals. Diameter of driving wheels to be 30 in.

Motors.—Two to be supplied per car, of the G.E. 52 type.

Wearing Depth of Commutator.—1 in. radial, or 2 in. from diameter.

Ratio of Gear.—To be 1 to 4·78.

Weight of Motor.—Weight of motor, complete with gear case, not to exceed 1,750 lbs.

Test.—All insulation to stand 2,500 volts alternating between windings and frame for 15 consecutive minutes.

Controller.—To be of the General Electric Company of America's B. 18 type arranged with rheostatic brake.

Trolley Pole.—To be of the enclosed spring swivelling arm type, 16 ft. long, fitted with Wood's spherical swivelling trolley head.

Date of Delivery.—To be stated by tenderers, also the dates of commencement and number per week thereafter.

Penalty for Late Completion.—One per cent. of value of each car late.

Terms of Payment.—Up to 75 per cent. of value of labour expended and materials delivered on site during construction, an additional 12½ per cent. on completion of the work, the remaining 12½ per cent. 12 months later.

Period of Maintenance.—Twelve months from date of completion.

Stipulations as to Removal of Foreman.—Satisfactory, see comments below.

Stipulations as to Wages Paid to Workmen.—None.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—February 17th, 1902.

This specification has been issued by Mr. E. W. Monkhouse, the consulting engineer for traction purposes, of the Croydon Town Council.

It will be noted that throughout the whole specification a distinct preference has been shown for apparatus similar to that already in use. We consider that in distinctly mentioning certain makers, as in the case of equipments, and binding all tenderers to make offers for one particular type of motor and controller, the consultant is exceeding his due function. It is his duty to specify his requirements and to guard his clients' interests by seeing that those requirements are fulfilled; it is the right of the tenderer to choose his own method of offering to meet them.

This is the only point on which we wish to comment with regard to the technical conditions. For the rest we may say that the specification is very clear and free from the ambiguities which often go far to make the life of those whose duty it is to interpret the conundrums set in many engineers' specifications, a perfect worry to themselves and a nuisance to others.

The date of completion, together with that at which the contractor will engage to commence delivery, is to be given in the tender, the penalty for failing to meet these dates being 1 per cent. per week of the value of each car late.

Stringent powers are reserved to the engineer to act should the contractor refuse to remove from the works any employé to whom the engineer may object, but it is distinctly stated that these powers will not be used until the contractor has been given every opportunity of complying with the engineer's wishes.

The terms of payment are slightly different from those usually observed, 12½ per cent. of the contract sum being retained for a period of 12 months. The arbitration proposals are thoroughly satisfactory, and there are no stipulations regarding the conditions under which workmen are to be employed.

THE TESTING OF MOTOR LOSSES.*

By W. E. SUMPNER, D.Sc.

In the case of direct-current machines the well-known Hopkinson method is admirably adapted to determine the temperature after a long run, and the losses under various conditions of load. The method can be applied to alternators, whether single-phase or multi-phase, when two similar machines are available. In the case of single-phase dynamos, only one machine is necessary, since any multipolar alternator can be regarded as a number of similar machines coupled in series. [See *Proc. Inst. Elec. Eng.*, February, 1893: W. M. Mordey on "Testing and Working Alternators."]

For the separation of the losses in direct current dynamos and motors the best known method is that of Kapp and Housmann. This method requires only the simplest possible instruments, and is well suited for workshop testing. It has an advantage over the Hopkinson method in that it only requires the one machine under test. The method may be extended to alternating current machinery, but all the simplicity is lost. The instruments required are not usually available in works, and, especially for the case of polyphase machines, the testing becomes complicated.

A better method for alternators is to run the machine at various speeds and excitations by a separately excited direct current motor, measure the power supplied electrically to the latter, and allow for the losses.

But a difficulty arises in applying this method to machines having heavy revolving parts. Suppose a current of 40 amperes in the motor is just sufficient to balance the losses and maintain constant speed, and let the current increase to 44 amperes. The accelerating current will be 4 amperes, exerting a torque one-tenth of that due to friction, and the machine will speed up at one-tenth of the rate at which it would slow down on open circuit. Now with heavy machines this drop of speed may occur very slowly, at a rate of less than 10 per cent. per minute. In such a case the motor current could be anything from 36 to 44 amperes without the speed changing more than 1 per cent. per minute, and with ordinary speed indicators the speed would seem constant for any current between those limits.

It seems desirable in such cases to use some method in which the kinetic energy of the running machine forms the source of power, and from the way in which the machine slows down under the retarding torque due to frictional and other losses, the magnitudes of these losses are deduced. The idea of utilising the inertia of the running machines for such a purpose has been previously suggested by Ashworth, Routin, and others, but the methods recommended have been suitable rather for the laboratory than for the workshop. A number of references, and a good account of several of these methods, will be found in articles by Prof. Hay, printed in the Electrical Review for August, 1900.

Acceleration methods of this kind will be good or bad according as the instrumental methods used for making the observations are or are not sufficiently accurate and simple to apply. In each of the three methods below, the process suggested for making the measurements possesses some advantages over others previously published.

The first method, which has been successfully used for several years past in the classes of the Birmingham Technical School, can be recommended on account of its simplicity. The only apparatus required are an ordinary watch, a good speed indicator, and some means of applying to the machine a small measured retarding torque either mechanically or electrically.

* Institution of Electrical Engineers, Birmingham Local Section December 11th, 1901.

Observe (by counting the number of ticks of a watch) the time taken for the machine to slow down between two given speeds R_1 and R_2 as read by the speed indicator. The loss of kinetic energy of the revolving mass is—

$$a\,(R_1^2 - R_2^2)$$

where a is a constant depending on the moment of inertia of the rotor.

If T is the retarding torque due to the losses in the machine, T varies very slowly with the speed, and can be regarded as constant during a change of about 10 per cent. in the speed R. If T is constant, R diminishes uniformly, so that the work done in the interval t is—

$$2\,\pi\,T\,\frac{R_1 + R_2}{2}\,t$$

whence—

$$T\,t\,\pi\,(R_1 + R_2) = a\,(R_1^2 - R_2^2),$$

or—

$$T\,t = \frac{a}{\pi}\,(R_1 - R_2). \qquad (1)$$

If, therefore, in different experiments, we alter T but keep R_1 and R_2 the same, the value of T is inversely proportional to the corresponding value of t. If by increasing T by a known mechanical torque T_0 the value of t is altered to t',

$$T\,t = (T + T_0)\,t',$$

or—

$$T = T_0\,\frac{t'}{t - t'} \qquad (2)$$

and—

$$T\,t = T_0\,\frac{t\,t'}{t - t'} = \frac{a}{\pi}\,(R_1 - R_2), \qquad (3)$$

which determines a, and hence the kinetic energy at speed R.

T may now be altered by varying the excitation of the machine, and in other ways, so that the torque due to hysteresis and eddy-currents can be separated from that due to friction. Moreover, by use of equation (3) the torque at different speeds can be determined.

If the constant in the equations is determined electrically by applying a torque due to a current generated by the machine,

let W = the watts wasted due to the machine losses,

and let w = the watts generated by the machine in the calibration test,

we then have—

$$W\,t = (W + w)\,t' = a\,(R_1^2 - R_2^2),$$

or—

$$W = w\,\frac{t'}{t - t'} \qquad (4)$$

and—

$$W\,t = w\,\frac{t\,t}{t - t'} = a\,(R_1^2 - R_2^2),$$

and similar remarks apply.

This method is capable of yielding good results even with small machines when a good speed indicator is available. With very little practice the method of counting the time interval by the number of ticks of a watch becomes more accurate than by use of a stop-watch, so that an ordinary watch is all that is necessary. The limit of accuracy is determined by the speed indicator. A good tachometer will be found accurate enough in most cases.

The form of equation (3) shows that to get a good result t' should be about half of t. To read t' accurately it should not be less than $2\frac{1}{2}$ seconds, or 10 quarter-second ticks of the watch, so that t should not be less than 5 seconds, and thus $R_1 - R_2$ in (3) should not be less than the change of speed in this time. Now small machines take about 30 seconds to slow down from full speed to rest, and the change in R in 5 seconds will be nearly 20 per cent. With large machines the time of slowing down may exceed 30 minutes, or 1,800 seconds, so that the time intervals t and t' for a change of speed easily observed on the tachometer will be considerable, and can be readily measured. In all cases the method is easily applicable, when the speed indicator is at all reliable.

An entirely different method of observing the change of speed can be applied wherever there are large alternators working in parallel. The synchronising apparatus can be employed as the speed indicator by making use of the principle of beats. If the machines are running in synchronism, and power be shut off from one machine and its armature circuit opened, the synchronising apparatus will show more and more rapid beats. If it is possible to count the number n of beats occurring in a time t from the moment of opening the armature circuit, it can be shown that

$$\frac{T\,t^2}{n}$$

is a constant quantity for any particular machine (T being the retarding torque caused by the losses).

In the short time t the number of periods which occur will be, for dynamos giving p periods per revolution

$p\,R_1\,t$ for the first alternator,

and

$p\,(R_1 + R_2)\,\frac{t}{2}$ for the second alternator.

These quantities will differ by n,

$$\therefore\ p\,R_1\,t = n + p\,(R_1 + R_2)\,\frac{t}{2},$$

or

$$2\,n = p\,t\,(R_1 - R_2).$$

If the frequency of the current is $f = p\,R_1$

$$2\,n = f\,t\,\frac{R_1 - R_2}{R_1}. \qquad (5)$$

But by (3)

$$T\,t = \frac{a}{\pi}\,(R_1 - R_2)$$

$$\therefore\ \frac{T\,t}{2\,n} = \frac{a\,R_1}{\pi\,f\,t}$$

or

$$\frac{T\,t^2}{n} = \frac{2\,a\,R}{\pi\,f} = \frac{2\,a}{\pi\,p}. \qquad (6)$$

Thus T is proportional to the number of beats occurring in a given time, or inversely proportional to the square of the time taken for a given number of beats. If both t and n are observed—

$$\frac{T\,t_1^2}{n_1} = \frac{T'\,t_2^2}{n_2}$$

and if in the second experiment $T' = T + T_0$

$$T = T_0\,\frac{\dfrac{t_2^2}{n_2}}{\dfrac{t_1^2}{n_1} - \dfrac{t_2^2}{n_2}}. \qquad (7)$$

The number of beats occurring in a time t is proportional to t^2. Whether or not these are too quick to count will depend on the values in equation (5).

$\frac{R_1 - R_2}{R_1}$ is the fractional drop of speed in time t.

Supposing a is the fractional drop of speed per second, then

$$\frac{R_1 - R_2}{R_1} = a\,t,$$

and

$$2\,n = a\,f\,t^2. \qquad (8)$$

Thus if the frequency of the current is 100 per second, and the speed falls 1 per cent. per second, $n = \frac{1}{2}\,t^2$, or in 4 seconds there will be eight beats; and the method becomes rather too sensitive for easy measurement, as the beats will occur rapidly. But with large machines, and the moderate frequencies now common, the beats will not occur with inconvenient rapidity. Thus for a machine taking 10 minutes to slow down from full speed to rest, and for a current frequency of 50 periods, the time for four beats will be about 100 seconds, and can easily be observed.

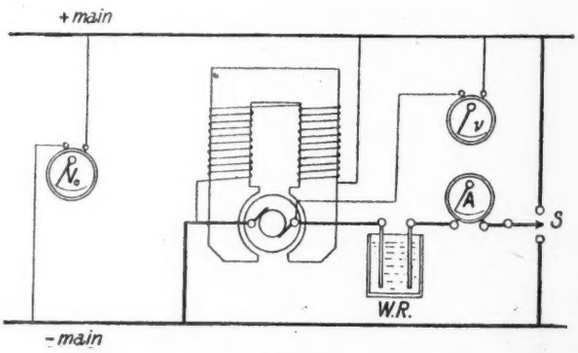


FIG. 1.

If the machine tested is a direct current shunt machine, or an alternator provided with an exciter on the same shaft, or any machine which is run up to speed by means of a belted shunt motor, a much better method of measuring the change of speed is available without the use of a speed indicator at all. The method consists, as indicated in fig. 1, of using a suitable low voltage voltmeter to measure the difference between the voltage of the field-magnet coils and the induced E.M.F. in the armature. The field-magnet is permanently connected to constant potential mains, the armature being connected across these mains through a switch and starting resistance, the switch end of the armature being also connected to the corresponding main through a voltmeter provided with a key. When the desired speed is attained the armature switch is opened and the voltmeter key closed. The reading of the voltmeter is a direct measure of the change of speed $(R_1 - R_2)$ in (3). The method, then, merely consists in observing the time interval taken for the voltmeter to change its deflection between two given values, and formulæ (2) and (4) apply. When this method is applicable the speed readings can be very accurately taken.

The only novelty in the suggestion of using a voltmeter as speed indicator arises from the special way in which it is connected. Instead of joining it up across the armature so as to indicate the total speed of the machine, it is connected so as to measure the difference between the constant voltage corresponding with the normal speed and the actual voltage due to the reduced speed. It is thus possible to use a sensitive voltmeter capable of indicating by a considerable deflection small changes in speed. This is a great advantage, for in these acceleration methods the time measurements can be much more accurately taken than the speed indications. It is, besides, desirable to make the measurements for a small percentage change in the speed.

To test this method, experiments have been made on one of the three Parker dynamos in the engine room of the Birmingham Technical School. Each dynamo gives at full load an output of 40 units at 110 volts, the speed being 800 revolutions per minute.

It is belted to a Tangye gas engine running at 160 revolutions. Both engine and dynamo are provided with heavy fly-wheels. The engine running alone takes 2 minutes to slow down from full speed to rest. When belted to the dynamo, this time is increased to 4 minutes. The time of slowing down of the dynamo alone, on open circuit, is 22 minutes.

The slow acceleration of the machines, owing to the excessive inertia of the revolving parts, was no advantage in the tests, since the time intervals could be measured much more accurately than the angular movement of the pointer of the voltmeter. If the machines had slowed down more rapidly, the use of a lower reading voltmeter would have secured equal precision.

The only instruments needed for the test were a watch, a voltmeter, an ammeter, and a common water resistance. It was not found necessary to alter a single connection between the dynamo and the switchboard. The field coils were permanently excited from the bus bars. The armature had its negative brush permanently connected with the negative bar, and its positive was on open circuit except when connected through the ammeter and water resistance to one of the bus-bars (the positive bar for speeding up and the negative for slowing down).

(To be concluded.)

WIRELESS TELEGRAPHY.

By H. W. SULLIVAN.

In view of wireless telegraphic developments, some notes upon the history, and present and future prospects of the new enterprise as an industry, may be useful, the more so because of the extravagant hopes which have been raised in the public mind by announcements in the lay Press, especially recently, as to the capabilities of the new system. Nothing could be more unfortunate to investors than that false ideas upon this subject should prevail, and be tacitly fostered in responsible quarters. It is because of its great fascination that the new telegraphy must be calmly and cautiously considered.

The important and original experiments carried out in 1895 for the Admiralty by Captain H. B. Jackson, R.N., F.R.S., constitute the first official and practical wireless telegraphic work in this or other countries. The first public "wireless" trials were those conducted by the Postal authorities early in 1897 between Lavernock Point (Penarth) and Brean Down (Weston-super-Mare), a distance of some nine miles, with the small island of Flatholm intervening about half way. Messages were then successfully exchanged at fair speeds and recorded, as in the prior Admiralty experiments upon a Postal-pattern Morse inker.

The writer had the privilege of witnessing some of these early and highly interesting demonstrations. Since then the signalling range has been increased by degrees, until latterly ordinary Morse signals have been picked up at distances amounting, under exceptionally favourable conditions, to 300 miles, whilst the rate of transmission has also been accelerated. There is no reason why, with more sensitive coherers, these results should not be surpassed, except for certain practical objections, which will be referred to presently.

Without doubt, although the transmission at distances of 300 miles is exceedingly uncertain, this achievement is a great advance, and, at first sight, is full of promise for the future. Unfortunately, however, the main and fundamental objections which were urged against the system upon its first introduction to public notice still remain practically in full force. Foremost amongst these are :—

1. The impossibility of so screening or syntonising messages that they shall not be interrupted or read by any other system of the same nature.

2. It is at all times subject to *designed* interruption on the part of others.

3. Its liability to interference from atmospheric disturbances, and also damp and rainy weather.

4. The still slow speed of transmission, even over the limited distances attained.

As regards objections Nos. 1 and 2, to the best of the writer's knowledge, no physicist has come forward with even a theoretical suggestion as to how messages are to be rendered secret or screened against interruption, intentional or otherwise, in a practical way, notwithstanding irresponsible statements, implying the contrary, which have so repeatedly appeared in the daily press. One may search in vain for any reliable patented information upon the subject. This defect would seem to have been strikingly illustrated only so recently as at last year's yacht race between *Shamrock II.* and *Columbia*, when, according to press statements, two steam tugs, fitted respectively with the Marconi and another system, which were present to report the race, finding interference from each other's signals, agreed to transmit reports alternately for periods of five minutes each, only to have both their messages mutilated and rendered unintelligible by a third boat, equipped with a rival system, which then appeared.

With regard to objection No. 3, as is now well known, the idea that wireless telegraphy is proof against atmospheric disturbances or weather changes has been exploded by facts. At times the interference from this cause is very severe. Upon several occasions the writer has witnessed trials when even with beautiful sunshine and calm weather prevailing at and between two stations and with the instruments at both stations idle, erratic signals kept on being recorded at frequent and irregular intervals throughout the day, whilst during working periods these stray signals interfered considerably with the reception of messages. They could be traced to the operation of no other wireless installation within range, and were clearly due to atmospheric effects, howsoever caused.

In the first instance it was supposed that the effective range of wireless telegraphy depended directly upon the length and volume of the spark produced and upon the coherer being very highly sensitive. Subsequent experience has modified this idea. As a matter of fact, messages are now successfully exchanged over distances of many miles with much smaller spark gaps and less sensitive coherers than were originally supposed to be necessary. A somewhat analogous case occurs in the history of submarine telegraphy, in the early days of which it was thought that to successfully establish communication through an Atlantic cable, electrical energy of enormous power or tension was essential.

The present maximum working speed of wireless telegraphy is from 20 to 25 words per minute, and the signals have been made continuous instead of the dots and dashes forming, as they did originally, a short series or a long series of minute dots.

As mentioned above, greater signalling ranges can be attained by the simple expedient of so increasing the sensibility of the coherer as to make it respond to the attenuated impulses reaching it from afar, but certain practical objections to this course exist. These objections are the exceedingly uncertain working of hyper-sensitive coherers, and also their greater susceptibility to atmospheric and other foreign disturbances, which trouble, of course, becomes accentuated with the necessity of using more and more sensitive coherers.

Speaking generally, the improvements which have been introduced in the system are due to detailed refinements in the *receiving* apparatus, and mainly so to the introduction of the step-up transformer in the coherer circuit, the idea of which was first patented by Oliver Lodge in May, 1897. Not only does this device in itself greatly increase the signalling limits, but it may also render the receiving instruments less susceptible to the atmospheric and other disturbances which have been referred to herein. At first sight it should have the effect of remedying all trouble due to such disturbances, but for reasons which, upon consideration, will be obvious this is far from being the case. Oddly enough, the significance of Dr. Lodge's priority of idea in this important invention does not appear to have been grasped by subsequent inventors and authorities upon the literature of the subject.

Alluding to the fascinating wireless experiments just made between the British Isles and Newfoundland, when, as we are told, a pre-arranged signal in the Morse code alphabet was successfully transmitted across the North Atlantic, Messrs. Marconi and Co. must be congratulated ungrudgingly upon the brilliancy of this feat. It is worth noting than the signal in question is said to have been received upon a *telephone*. The

telephone diaphragm would respond to minute differences in amplitude of magnetic waves of great tenuity, and reproduce with fidelity sounds or signals propagated through the æther, with the high tension currents magnified by marvellously high frequency, such as were doubtless used at the Lands End, in contradistinction to the low tension and low-frequency currents of cable circuits. It in no way detracts from the interest of the achievement that the telephone is an instrument unsuitable for the reception of telegraphic messages, wireless or otherwise, and that with an apparatus of such delicacy, the practical difficulties to some of which the writer has alluded, will be aggravated in an extraordinary degree.

Will "wireless" supersede submarine telegraphy? Before it can do so, if ever, it seems reasonable to suppose that it must pass through the same successive stages of evolutionary development, and invoke to its aid the services of many physicists and earnest and future workers and practicians in this field of study. At present those accustomed to the secrecy and speed, and the smooth and certain working of submarine telegraphy in all weathers and climates, cannot but realise the crudeness and defects of the new system, even in its now improved condition. The latter will stimulate invention towards further developing the marvellous capabilities as regards secrecy, speed, and certainty of transmission of the metallic path of a submarine cable, with its property of focussing and confining rigidly between two given points, howsoever distant, impulses or waves, the most minute of electrical energy.

Wireless telegraphy has, however, other and obvious fields of usefulness, *e.g.*, for ocean signalling, more especially on men-of-war, where it will be handled under a carefully-organised system by skilled executive officers, specially selected from those who have undergone the requisite technical training, instead of this complicated and delicate apparatus being consigned to the mercies of an ordinary signalman; though it is only fair to point out that in this field, too, improvements are necessary.

TECHNICAL TERMINOLOGY.

ONE of the most remarkable features of electrical science is the accuracy of its measurements. Although its development, subsequent to its prolonged chrysalid stage, has been confined within so brief a period compared with that of steam practice, for example, there is now probably no other separate science in which such refinement of accuracy is even possible, and certainly no other in which everyday measurements are maintained at such a high standard as a matter of course. Indeed, the ease and accuracy of electrical measurement have been most important factors in hastening the process of development. How comes it, then, that so many of those in whose hands this marvellous and beautiful system of units and measurements has been placed, daily and hourly abuse it, often through ignorance, but no less often from sheer laziness? We rejoice in the knowledge that our technical colleges are rapidly multiplying and increasing the scope of their labours, and that the precision in definition and in application of scientific terms which they inculcate must in time have its due effect; but they cannot cure the fault which takes its origin in sloth. As for the other source of misuse—ignorance of theory, at once the mistaken pride and real shame of the man who boasts that he is a "practical man"—were those who know but careful to speak and write correctly, the less well-informed would inevitably follow their lead.

We propose to draw attention once more to the graver errors in terminology, as well as to terms which are not in themselves erroneous, but are susceptible of improvement.

HORSE-POWER-HOUR.—Probably there is no error more prevalent than the use of the phrase "horse-power" as a unit of work. For example, we are told that a certain plant consumes x lbs. of coal per horse-power, a statement which is really the purest nonsense. One might as well say that a dynamo generates y amperes per second. It is all very well to reply that it is common practice—that the time element is "understood"; sometimes it is, but often it is not, and even if it were, this would be no justification for a slovenly mode of expression. Those who clearly understand that a horse-power is a rate, and a horse-power-hour is a quantity of energy, are careful to use the correct phrase.

KILOWATT-HOUR.—A similar error, inexcusable in an electrician, is the use of the word "kilowatt," where kilowatt-hour is meant; a steam dynamo, for instance, is often said to consume so many pounds of steam per kilowatt. It is nonsense. "Pounds of steam per kilowatt-hour" is the correct phrase, though "thermal units per kilowatt-hour" is better when it can be ascertained.

RECORDING WATTMETER.—This misnomer came to us from the United States, and is one of the most objectionable imports that our American friends ever introduced to this country. A recording wattmeter records on a chart the power in use at any instant, and has nothing to do with Board of Trade units, unless the record is independently integrated. What is usually meant by the term is an "energy-meter," "watt-hour meter," or "integrating wattmeter;" any one of these terms is correct.

ENERGY.—How often we read of the "revenue from sale of current," "demand for current," &c.! Yet current is neither demanded nor sold; it is not worth having, as one cannot do anything with it when one gets it! "Energy" is the commodity dealt with, and current is not energy.

QUANTITY METER.—The amazing confusion of ideas manifested by counsel in a recent patent action between two electrical companies was due to a similar cause—the inability to distinguish between current and quantity. Lengthy arguments were made to show that a certain meter was not an energy meter, but a current meter. Without pausing to demonstrate the fallacy of the arguments, we must point out that the phrase "current meter" is solely applicable to what is generally known as an ammeter; "quantity meter," or "ampere-hour meter," is the correct designation for an instrument which integrates current with regard to time.

CANDLE-POWER.—Our friends the gas people have been active, of late, in the dissemination of "tracts" aimed at the perversion of the multitude to the cult of gas; these tracts generally take for their text the Welsbach mantle *versus* the electric glow lamp. There is nothing they hate more, in point of fact, than the former—except the latter; but it suits their purpose, which is to persuade people that gas is the cheaper, and then to get them to use batswing burners. We shall deal with them at another time; our present purpose is to expose their ignorance of the subject. They speak of "candle-power per cubic foot," when they mean "candle-hours per cubic foot," and worse, they say "so many candles per hour," when they mean merely "candles"! We have the actual statements before us.

FREQUENCY.—Seeing that there is a definite physical term ready to hand for the rate of repetition of a periodic function—its *frequency*—why should we use a word of six syllables—periodicity—to express precisely the same thing? Let us adhere to the short, simple, and long-established "frequency," if only for the sake of uniformity. There are already too many synonymous terms in the language of electricity.

By the way, what is the meaning of $\sim$? We know what cwt., £, ″, stand for; we translate them as hundredweights, pounds, inches or seconds; but when we see $\sim$, what idea does it convey to our minds? Is it frequency? or cycles? or periods? or cycles per second? In a work on "Transformers," written by a well-known and popular engineer, we read that $T = \frac{1}{\sim}$, where T is the time required for a complete cycle. A few lines further on we read "a speed of $\sim$ revolutions per second." Again, we find "$E = 2\pi \sim N n \sin \alpha$." What are we to call $\sim$? Reading the formula, we say "E equals two pi (?) big-N, small-n sine alpha;" we have just used $\sim$ as a number, but when we come to the E.M.F. formula, we have, presumably, to use it as cycles per second. But supposing the meaning of the symbol to be confined to cycles per second, what is the *name* of the symbol? Fortunately, the symbol is doomed, for no lecturer can use it, unless he is lecturing by signs to a deaf and dumb audience!

PRESSURE.—We have referred to the redundancy of electrical terms; nowhere is this more marked than in the case of pressure. There are two things to be named—*electro-*

motive force and *potential difference*, and these are quite distinct and definite; yet we call them at random, E.M.F., voltage, pressure, potential, P.D., tension, and juice! Surely there is no need for this absurd confusion. Electromotive force, singular to state, rarely comes within the purview of the majority of electrical engineers; it is appropriately and conveniently styled E.M.F. What we have to deal with in everyday life is difference of potential. Long ago Prof. Ayrton foresaw the need of a brief term for this quantity, and suggested P.D.; this would answer perfectly, were it not that the average electrician knows but little about potential, and is doubtful as to the meaning of P.D.

What is voltage? We appeal for a definition. Potential is absolutely inadmissible. Tension implies a pulling apart, and is, indeed, capable of justification; but after all, what can be better than *pressure*? Everybody is familiar with the idea in connection with steam, air, and water, and the quantity is one which must often be referred to by people who are largely ignorant of electrical matters, but are acquainted to a greater or less extent with the corresponding quantity in mechanical subjects. Moreover, the Board of Trade has hallowed the word with its weighty sanction. It is as easy to speak of high or low pressure as of high or low tension; let us bow to the Board of Trade's example, and speak only of *pressure*.

Conductance.—The use of the word conductance, as the reciprocal of resistance, and of conductivity as reciprocal to resistivity, is so simple and obvious an improvement, that no justification is needed for it. Fortunately, this reform has gained a strong foothold, and some day even the compilers of electrical pocket-books will doubtless hear of it.

0000.—A fault which, we regret to say, even cable makers have committed, is the use of the symbols 4 0, 3 0, &c., in place of 0000, 000, &c. We have no excuse to offer for these extraordinary symbols; but the fact is, that the symbol 7/16 means seven wires of No. 16 S.W.G., and consequently 4/0 means four wires of No. 0 S.W.G. Probably no one is misled by this misuse of the symbol, but why should it occur at all? It is, like so many others, mere laziness, without the excuse that it saves time or trouble.

High and Low Speed.—The common practice of discussing "high and slow speed" engines is most irritating to anyone with any regard for verbal accuracy. The antonym of "high speed" is "low speed;" if we prefer to speak of "slow speed," we must also use the expression "quick speed" in place of "high speed." We never refer to "high tide and slow tide," or to "quick walking and low walking;" let us then be reasonably consistent, and use "high and low" *or* "quick and slow," but never an absurd mixture.

RECENT DEVELOPMENT OF THE ATOMIC THEORY AND ITS CONNECTION WITH LIGHT AND ELECTRICITY.

By C. C. Garrard, Ph.D.

(*Concluded from page* 207.)

While all these methods enable us to arrive at a conclusion as to the nature of the ions, electricity gives us the means of decomposing chemical substances into their component parts, in that during the operation of electrolysis the ions are deprived of their electric charge, and are deposited in a neutral state. By means of the voltage necessary for this decomposition one overcomes the force tending to keep the ions charged, and as we can raise the voltage as high as we like, it is possible to overcome the strongest chemical affinities. By this method Davy was able to electrically isolate the alkali metals, and Moissan the element fluorine.

When now, on the other hand, a metal goes into solution, under formation of ions, it follows that a displacement of electricity must occur, this being, according to Nernst's well-known theory, the origin of the electromotive force of the galvanic element. Such dislocations of electricity also occur in simple chemical reactions, such as the dissolving of a metal in an acid. Here the electric charges of the hydrogen ions are transferred to the metal, which thus goes into the ionic form.

One could, therefore, well imagine that all chemical forces are electric in nature. A great analogy between chemical and electrical action is indeed quite obvious, in that chemical action proceeds directly proportional to the driving force of affinity and inversely proportional to the chemical resistance in a way similar to Ohm's law, so that one has to regard the E.M.F. of a galvanic element as a measure of the affinity of the chemical reactions occurring therein. This electrical method for measurement of chemical affinity is the most accurate known, though it is not the only one.

These considerations, however, naturally do not give any proof that the force of chemical affinity is really electrical in nature. Indeed, it has been held by some that it is sufficient to know the strength and amount of the force without bothering about the actual nature of the same. Nernst, however, holds that this view is not the right one, and that we should endeavour to pierce the veil and get to know the actual mechanism of the action which is going on.

The Berzelius theory of chemical affinity, which regarded all compounds as being dualistically composed of a positive and a negative electrical radicle could not hold its own against the development of organic chemistry, where, for a great class of chemical bodies, the unitistic idea, founded on the Valence theory, seemed to apply. To-day both ideas appear to be justified in that we distinguish between positive and negative ion builders—*i.e.*, elements and radicles which are capable, under favourable conditions, of taking up the different electric charges. While, however, Berzelius explained the strength of the chemical affinity by the amount of the electric charge, we know, as shown by Faraday, that equivalent amounts of even the elements, of the most different affinities, have exactly the same sized electric charges. These strange facts now are capable of a very simple explanation, if one assumes an idea first put forward by Helmholtz, and regards electricity as material in nature, and also of an atomistic structure, consisting of positive and negative electrons; and accordingly the ions as compounds of the elements with such electrons. Other, quite different investigations (described in the beginning of this article) can be said to lead also to such a chemical theory of electricity, and according to which we may say that the atomic weight of the negative electron is $\frac{1}{2000}$th.

The idea of the ions as saturated chemical compounds of radicles and electrons leads to many conclusions which stand in the best agreement with known facts. Thus, for example, the sodium ions are as much different from elementary sodium as is sodium chloride. For further development of the chemical analogy between electrons and chemical radicles and elements the work of Abegg and Bodländer* can be referred to.

The last consequence of this idea, the existence of a compound of + and − electron, is not yet capable of proof, yet Nernst is of opinion that it is possible that it is this molecule which plays an important *rôle* in the ether.

The relation of the dualistic and unitistic standpoints can be best set forth, on this basis, as follows:—All elements or radicles possess an affinity for the positive or negative electrons with which they form ions, as also an unipolar attraction for each other. It is this latter attraction which accounts for the combination of the two hydrogen atoms to a hydrogen molecule, further the existence of phosphide of sulphur, iodide of chlorine, &c., or the metallic compounds, above all the carbon derivatives.

With the reaction, however, of a positive and negative element, one with another, an electron molecule is added, and with the ionic dissociation split up, and it appears to be particularly worthy of consideration that such compounds obviously, by reason of the addition of electrons, differ considerably more from their components than the compounds of like elements, by which it seems electrons do not play a part. For instance, the metal compounds remain metallic, the compounds of metalloids, metalloid in character, while, *e.g.*, with the compound of sodium (ion) with chlorine (ion) the formed body is something entirely different.

* See *Jahrbuch für Elektrochemie*, 1899.

It is possible, Nernst says, in finishing this summary of his views, that there are certain elements which only react with + electron, without another element binding the − electron, so that the latter is set in freedom and appears in the form of the Becquerel rays.

This theory, as worked out by Nernst, though very pretty and capable of giving a plausible explanation of many facts, rests obviously on a very slender experimental foundation; and although our comprehension of many things may be greatly helped by the simple picture it gives, we would do well not to accept it, for the time being, as the real physical explanation. For the present experiment would seem to show that what we have called negative electricity, consists of small particles chipped off the chemical atoms, and that a body is positively charged when it has had these small chips knocked off and removed from some of the atoms which constitute the body.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

2,084. "Improvements in joint and joint-boxes for electrical conductors." G. WILKINSON. January 27th.

2,094. "Improvements in tumbler and other electrical switches." A. WATSON. January 27th.

2,159. "Improvements in and relating to electric fuses." C. E. C. SHAWFIELD and E. P. WETMORE. January 27th. (Complete.)

2,187. "Improvements relating to galvanometers, magnetometers and like apparatus." T. E. GAMBRELL and C. T. GAMBRELL. January 28th.

2,201. "Improvements in or connected with massage and electro-therapeutical apparatus." D. R. PATERSON. January 28th.

2,228. "An improved means of transferring the conducting arms of electric tramcars and other vehicles (using the overhead wire) from one wire to another." F. W. WHITE. January 28th.

2,262. "A motive power for the production of electricity, &c., on sailing and other ships." G. A. CARRUTHERS. January 28th.

2,264. "Improvements in insulated electrical conductors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. Thomson and J. G. Callan, United States.) January 28th. (Complete.)

2,284. "Improvements relating to electric lighting." H. H. COOPER. January 28th.

2,310. "Improvements relating to electric telegraphy." A. MUIRHEAD. January 28th.

2,317. "Dry seats on electric cars or other vehicles, also for garden seats or seats or chairs exposed to weather." W. WALMSLEY. January 29th.

2,318. "Increasing the electrical conductivity of iron and steel." J. J. MORGAN. January 29th.

2,343. "Improvements in cooking stoves heated by oil, gas, or electricity." H. J. YATES and D. R. MCNEILL. January 29th.

2,352. "Improvements in automatic means of breaking electric circuits." J. FERGUSON and KELVIN & J. WHITE, LIMITED. January 29th.

2,354. "Improvements in and re'ating to apparatus for automatically con trolling electric switches." A. D. SMITH. January 29th.

2,363. "Improvements in and relating to portable electric accumulators." L. A. LAMMERTS. January 29th.

2,377. "Electric heating fabrics." J. M. C. HERRGOTT. January 29th.

2,425. "Improvements in and connected with etheric telegraphy." H. HEENAN. January 30th.

2,452. "Atmospheric ventilator for electric light, mains, tubes and channels." A. COKE. January 30th.

2,463. "Improvements in apparatus of use in starting and controlling electric motors." A. H. ADAMS and J. T. MOULD. January 30th.

2,477. "An improvement in lighting by electric incandescent lamps." J. A. HALFORD. January 30th.

2,492. "Improvements in connections for concentric electric cables." J. R. P. LUNN. January 30th.

2,498. "Improvements in casings for electrical conductors, gas and water pipes, and the like." J. D. PALMER. January 30th.

2,503. "Improvements in wires or cables for use on electric tramways." H. E. DOUGHTY and H. NORMANTON. January 31st.

2,513. "Improvements in electric storage flexible pressure gas batteries." E. BAILEY and A. CROWTHER. January 31st.

2,520. "Improved means of connecting isconnecting electric mains or cables in street boxes." S. E. BRITTON. anuary 31st.

2,521. "An improved disconnecting box for electric mains with means for rendering same gas and waterproof." S. E. BRITTON. January 31st.

2,525. "Improvements in jacquards." F. LANCASHIRE. January 31st.

2,552. "Improvements in electric couplings or terminals." E. HARDMAN. January 31st.

2,584. "Improvements in rheostats or electrical resistances." A. B. RIGBY, of THE ELECTRICAL TRANSMISSION COMPANY, and E. G. SCOTT. January 31st.

2,587. "An improvement in carbons for arc lamps." C. D. ABEL. (Siemens and Halske Aktien-Gesellschaft, Germany.) January 31st.

2,595. "Improvements in or relating to electric lighting of railway or other vehicles." M. BUTTNER. January 31st.

2,610. "An improved arm or support for holding telephone receivers or transmitters or the like." G. T. MORGAN. February 1st.

2,659. "Improvements in and connected with resistance switches for electric circuits." G. PAGE. February 1st.

2,666. "Improvements in brush-holders for dynamo-electric machines." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (H. F. T. Erben, United States.) February 1st. (Complete.)

2,673. "Improvements in electrically operated hand-drills." M. KEMMERHOFF. February 1st.

2,674. "Improvements in and connected with electric meters of the thermal type." M. P. THOMSEN. February 1st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d (in stamps).

1900.

9,533. "Method of exciting alternating current machines." P. M. J. Boucherot. Dated May 24th, 1900. In a method of exciting single or polyphase alternating-current generators or motors, the alternator is combined with a special excitiug-dynamo and a compoundage transformer. 4 claims.

9,534. "Improved method of starting and regulating multiphase-current motors." P. M. J. Boucherot. Dated May 24th, 1900. Relates to a method of starting and regulating multiphase-current motors, comprising the use of one or more specially-driven motors combined with apparatus termed a "phase transformer." Two "squirrel cage" or other motors are combined to form the motor. 2 claims.

9,552. "Improvements in electric arc lamps." H. Bremer. Dated May 24th, 1900. Arc lamps. A lamp is provided with four carbons, all inclined towards an arc which is formed at their lower ends; adjacent carbons are electrically connected. The arc is kept down by the magnetic field from a solenoid or one or more long pole-pieces, carried by a series electro-magnet at some distance above the arc. The pole-pieces are pieces of iron wire strand, in order that they may be bent to any desired position. Short carbons may be used, fed through a curved holder by a weight or otherwise, springs being placed in the curve of the holder to keep them in place. A small metal reflector is placed immediately above the arc. The carbons have their ends recessed and pointed to fit together and keep in alignment in passing through the curved holder. They are made with large proportions of metallic salts or metalloids, as described in Specification No. 21,637, A.D. 1899, to give a long arc, and to produce white or light yellow deposits on the reflectors; borax or salts of calcium or magnesium with fluorine may be used. The admission of air to the carbons may be limited by open cylinders as described in Specification No. 2,260, A.D. 1900. 10 claims.

9,563. "An electrolysing process for zincs and other salts with soluble anodes." C. D. Abel. (Soc. des Piles Electriques, Paris). Dated May 24th, 1900. Zinc, tin, cadmium, and magnesium, obtaining.—There are at least two porous vessels between the anode and cathode, and a continuous flow of a washing-liquid is kept up between them. The anodes of copper or other soluble metal, except zinc when zinc is to be deposited, are immersed in any conductive liquid, and the cathode of zinc or other metal to be deposited, is immersed in a solution of the salt to be electrolysed, which is contained in a porous vessel, and continuously flows from one tank to another by means of pipes. Surrounding this porous vessel is another one through which the washing liquid flows likewise from one tank to another by means of tubes. The washing-liquid may be a solution of the salt to be electrolysed, or of water rendered conductive. The apparatus is intended to be used with the primary batteries described in Specifications Nos. 9,803, A.D. 1897, No. 16,172, A.D. 1898, and Nos. 2,748, and 9,512, A.D. 1899. 1 claim.

9,567. "Improvements in electric traction on a road contact or like system." S. P. Thompson. Dated May 24th, 1900. Electric railways and tramways on a road contact, or like system, with switches operated by magnets on the vehicle. Switches; collectors.—A multipolar magnet on the vehicle is used to excite the switches, and it may be combined with the collector, but preferably a separate collecting-skate is used, so that the road switch boxes need not be insulated. 7 claims.

9,612. "Improvements in a commutating switch and combination of electric motors and batteries for controlling electric carriages and like purposes." H. F. Joel. Dated May 24th, 1900. Relates to means for controlling electric motors and batteries suitable for electric carriages, boats, or other machinery. A cylindrical switch, having eight positions, is employed. 3 claims.

9,647. "A process of depolarising by liquid circulation in galvanic batteries." C. D. Abel. (Soc. des Piles Electriques, Paris.) Dated May 25th, 1900. Relates to batteries such as are described in Specifications No. 16,172, A.D. 1898, and Nos. 2,748 and 9,512, A.D. 1899, in which depolarising action is effected by air, hot or reheated by contact with hot electrolyte, supplied to the battery in various ways. This invention consists in substituting the active and rapid circulation of the electrolyte, preferably hot, in whole or in part for the injection of air, described in the prior specifications. 2 claims.

9,654. "New or improved dies for making socketed conduits." J. Hamblot and I. Parkes. Dated May 25th, 1900. A three-sided socket is first formed by forcing clay into a mould, and the body of the conduit is afterwards produced by forcing the clay through a die. The rising and falling table is provided with a die or core of the internal shape of the socket, and cores or plugs for producing the passages are fixed to bridge pieces by the usual bolts. The mould descends with the table and socket until it comes in contact with the heads of the supporting bolts. Holes in the die allow air to escape while the socket is being formed, and rounded recesses are made in the die to produce the rounded ends of the partitions. 2 claims.

9,730. "Improvements in electric switches." F. S. Worsley. Dated May 26th, 1900. A switch fitted with a locking arrangement, and is operated by a key. 1 claim.

9,731. "Improvements in apparatus for use in the electro-deposition of metals." S. O. Cowper-Coles. (Patent not yet due for sealing.) Dated May 26th, 1900. Relates to apparatus of the kind described in Specification No. 21,974, A.D. 1898, for depositing metals, such as copper. 3 claims.

9,744. "Improvements in electric signalling apparatus." J. Lea and J. Taylor. Dated May 26th, 1900. Relates to electric signalling apparatus for use in communicating to the persons in charge of guns the distance of the object to be aimed at. 2 claims.

9,746. "Improvements in electricity meters of electrolytic type." A. Wright and Reason Manufacturing Company. Dated May 28th, 1900. A mercury voltammeter is made with electrodes of mercury separated from one another by two porous diaphragms, with the electrolyte between them; the diaphragms may form two chambers, which are placed side by side, or concentrically, and contain the mercury. 5 claims.

9,751. "Improvements in or connected with switches for electric tramways or sectional conductor and like systems." S. Eyre. Dated May 28th, 1900. Electric railways and tramways with mechanically-operated switches.—Switches: The switch is enclosed in a water-tight casing, and consists of a disc turned between the hinged contacts to complete or break the circuit by a link or other connection to a lever operated by the rod on the leading end of the vehicle A catch holds the lever down until it is struck by a second rod on the vehicle, and springs return the parts. The rods are adjustable so that the vehicle may run in either direction. 1 claim.

9,760. "Improvements in electrical maximum demand indicators." G. Hookham. Dated May 28th, 1900. A maximum-demand indicator consists of a float which is movable about vertical pivots in a vessel containing glycerine and water, or other viscous liquid, and which carries a pointer over a scale on the front of the vessel. The pointer and float are movable in one direction by a counterbalanced arm of a galvanometer needle which is suspended by a torsion wire and turned by two stationary flat coils carrying the current to be measured, or the current from a thermopile, of which one set of junctions is surrounded by a heating coil carrying the current to be measured. The float moves only slowly, and remains where it is placed by the action of the galvanometer. 4 claims.

9,767. "Improvements in coupling or connecting electric conductors, cables, and the like." T. J. McTighe. Dated May 28th, 1900. A sleeve of soft metal is slipped over the ends of the wires or cables to be connected, and subjected to considerable pressure. 2 claims.